SCIENTIFIC AMERICAN

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WEEKLY.

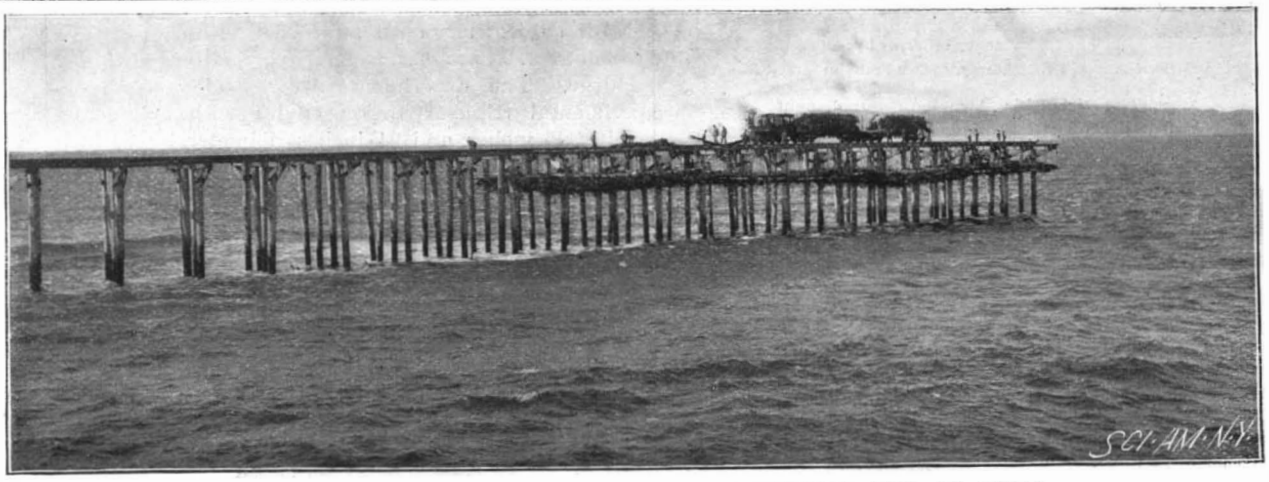
THE GREAT TRAINING JETTY AT THE MOUTH OF THE COLUMBIA RIVER, OREGON.

The successful completion of the Columbia River jetty and the permanent improvement which it has made in the entrance channel is another tribute to the genius of Captain Eads, the author of this method of harbor improvement. What he did for the entrances to the Mississippi his brother engineers have now accomplished at the mouth of the Columbia River.

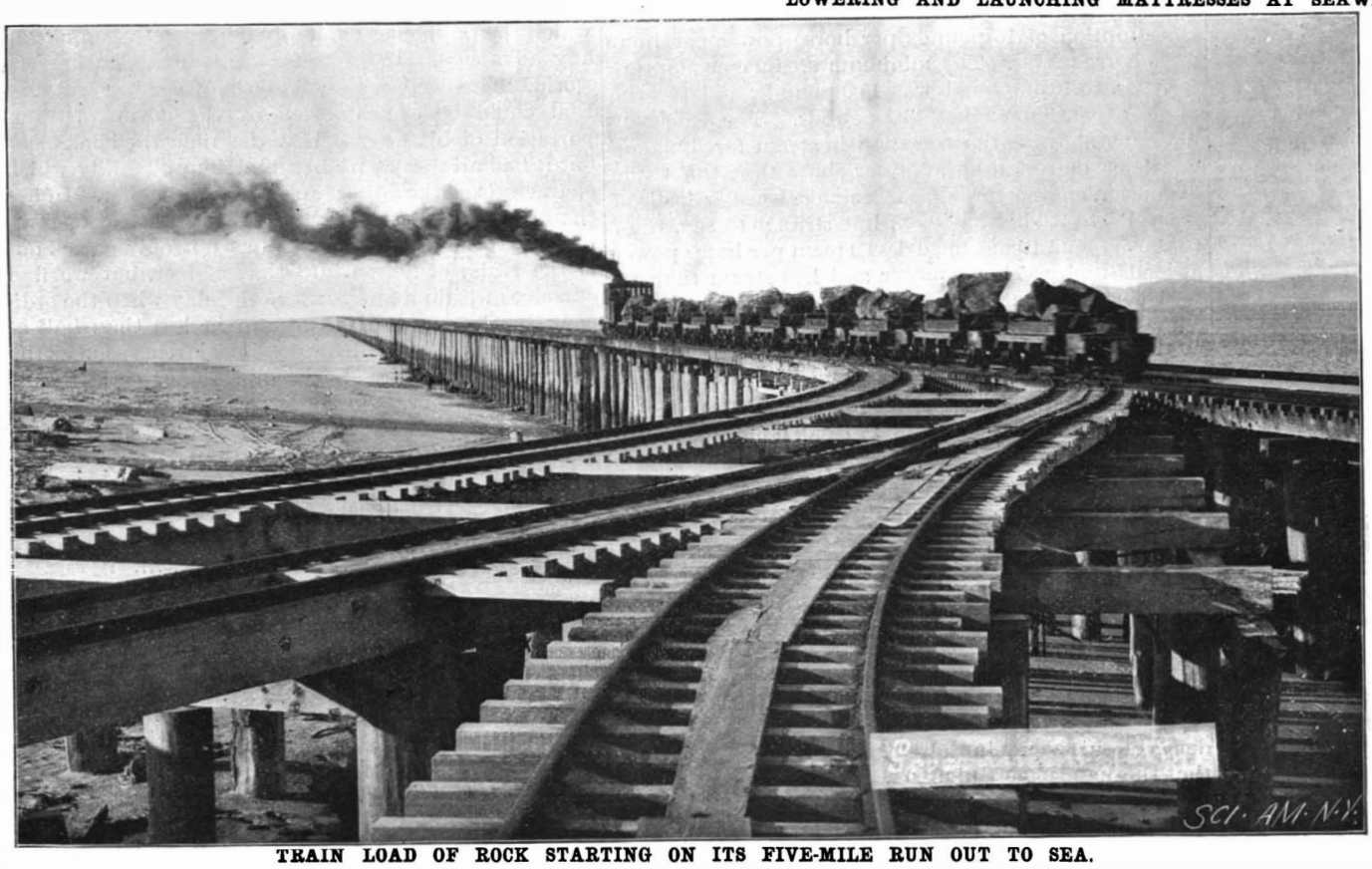
The theory of the training jetty is based upon the fact that the velocity of a given volume of water in passing through a channel in a certain time will be proportional to the area of the cross section of the channel. The smaller this cross section, the higher the velocity.

The lower reaches of the Columbia open out to a width of several miles, and the silt which is brought down the river is deposited by the now sluggish current at its broad mouth, forming in conjunction with the littoral drift of the sand a bar, which in former days was a serious hindrance to navigation. The plan of improvement contemplated the construction of a rock jetty on the south side of the entrance which should confine the outflowing tidal and river water, increasing its velocity and causing it to scour out a channel to deep water on the outside of the bar. The undertaking has been a brilliant success from the first, the improvement in the channel keeping pace with the seaward advance of the jetty. The original plans called for the construction of a pile and broken rock jetty, which should start from Fort Stevens on the southern side of the entrance and extend 4½ miles to sea. It was estimated that the total cost of the work would be $3,710,000, but the favorable conditions which prevailed, and the improved methods of work devised by the engineers, enabled them to carry the jetty nearly half a mile further to sea, or about five miles in all, and to complete the whole scheme for $2,025,650, or about 45 per cent less than the original estimate.

Before the commencement of the work there were two or more shifting channels across the bar whose depth was variable, ranging from 18 to 21 feet. It was rarely that any vessel of more than 1,300 tons register, or drawing over 21 or 22 feet of water, entered the Columbia, and the variable nature of the entrance necessitated a close watch upon the channels and an intimate knowledge of their condition upon the part of the pilots.



LOWERING AND LAUNCHING MATTRESSES AT SEAWARD END OF JETTY.



TRAIN LOAD OF ROCK STARTING ON ITS FIVE-MILE RUN OUT TO SEA.

The crossing of the bar, which required great caution at any time, became positively hazardous in boisterous weather, and the grain ships which arrived off the bar when a heavy sea was running, or the weather was thick, were liable to be detained on a dangerous lee coast for several days.

The work was commenced in 1885, and it very soon began to show a good effect upon the channel. As the work proceeded, the waters, confined by the rock work of the jetty, were prevented from flowing out toward the south and were concentrated to the north of the work. The increased velocity proved sufficient to scour out and carry to sea the intervening sand between the various channels, and a broad, magnificent entrance was formed which is now over two thousand feet wide and affords a low water depth of 30 feet. The new channel kept pace with the advance of the jetty, and now that the full five miles have been completed, the Columbia River is capable of admitting

(Continued on page 40.)

LOADING ROCK ONTO DUMP-CARS AT JETTY DOCK.

CONSTRUCTION OF THE COLUMBIA RIVER JETTY, OREGON.

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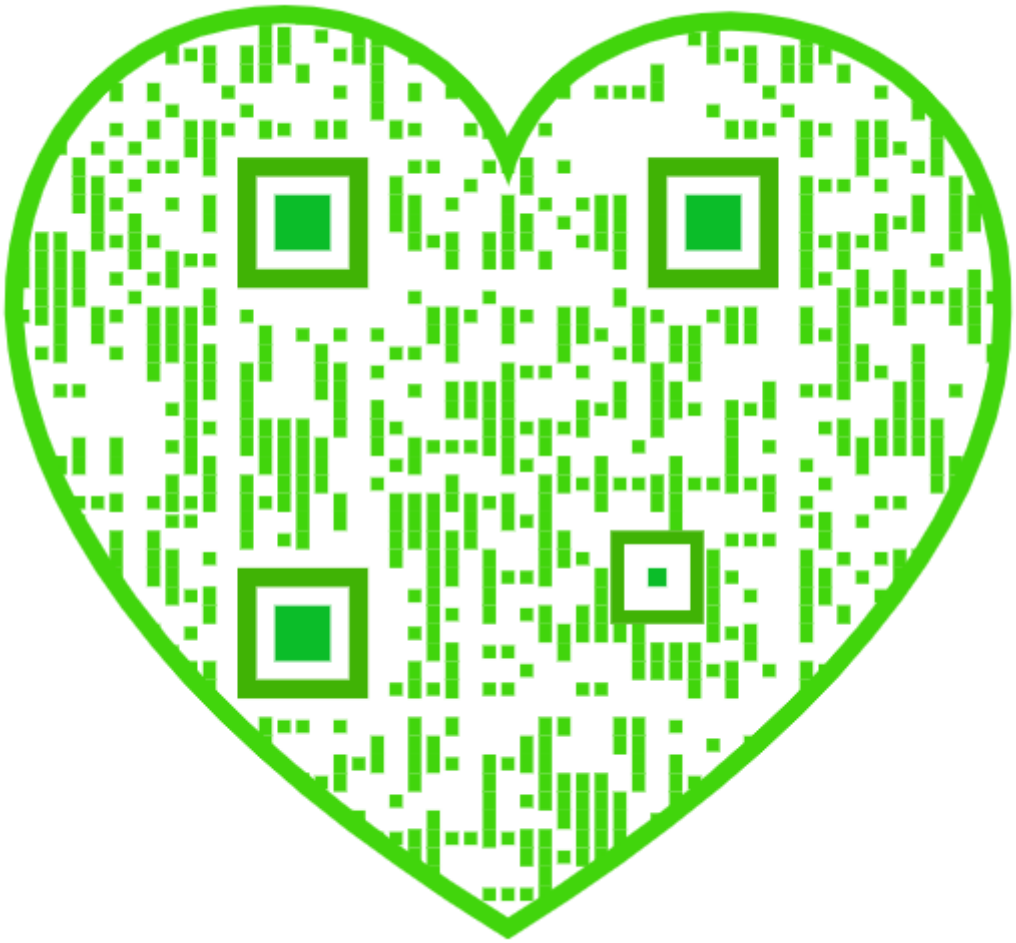

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CYLINDER RATIOS IN MULTIPLE-CYLINDER STEAM ENGINES.

The best ratio of expansion in multiple-cylinder engines has yet to be determined. At present there is considerable divergence of practice. Each builder is guided by his own conclusions, which are based more upon observation than upon any scientific tests. Locomotive builders are awaiting with considerable interest the results of the experimental work which is to be carried out upon the new locomotive at the laboratory of the Purdue University, which has been furnished with high and low pressure cylinders, the latter being bushed to enable various ratios of expansion to be tested. A valuable contribution to our knowledge of this subject has been afforded by a series of tests which Prof. Thurston has lately carried out at Sibley College. The experiments were made on an experimental triple-expansion engine with cylinders 9 inches, 16 inches, and 24 inches diameter, by 36 inch stroke. A compound engine with a cylinder ratio of 3 to 1 was produced by combining the high pressure and intermediate cylinders; another compound with a ratio of 7 to 1 was secured by combining the high pressure and low pressure cylinders; and the engine in its normal condition was used for the triple expansion tests.

The results were in some respects surprising, although previous experiments with the Rockwood compound engine had shown similar results. The diagram showing steam consumption per indicated horse power proves that at about 37 horse power the steam consumption was about the same in each case. Above this the 3 to 1 compound showed a minimum steam consumption of 18 pounds per horse power per hour at 75 horse power. The minimum steam consumption for the 7 to 1 compound was 15·8 pounds, and for the triple expansion engine 13·7 pounds. The efficiency diagrams showing the variation in steam for dynamometric or delivered horse power show that the triple expansion engine was most economical under loads of from 115 to 120 horse power; but strange to say, the 7 to 1 compound consumed less steam per horse power at loads under 85 horse power and less steam than a 3 to 1 compound at loads above 72 horse power. Mr. Thurston further proved that the most economical ratio of expansion for the 3 to 1 compound is 12 and 21 for the triple expansion engine. For the 7 to 1 compound the best ratio would probably be about 17. The conclusion is drawn that, after making all allowances, the triple shows an economy over the 7 to 1 compound of over 1 pound of steam per horse power per hour, and that a still larger gain is made by the 7 to 1 compound over the 3 to 1 compound.

ELECTRIC LOCOMOTIVES AT TERMINAL STATIONS.

Although the day when the electric will supplant the steam locomotive on trunk lines may be quite remote, it is steadily encroaching upon its domain in certain branches of locomotive work. The latest evidence of this comes in the shape of an announcement that the handsome Union Depot at Boston is to make use of electric locomotives and that no steam traction will be used within a mile of the station. The steam locomotives will bring their trains up to the electric yard, where they will be picked up and brought in by the electric locomotives. Outgoing trains will be similarly handled, being picked up by the steam locomotives at the limits of the electric yard. The proposed scheme is an excellent one and could be adopted by the existing terminal stations to great advantage. Though it might involve a slight delay and greater cost of operation, the gain to the traveling public and the locality surrounding the great terminals would be valuable in many ways. The handsome terminal structures themselves would be healthier and more cleanly. Any traveler with an eye to the artistic must have noticed how speedily the fresh painted ironwork of such a terminal as the Grand Central Station in New York, or the Pennsylvania Railroad Station in Philadelphia, is begrimed by the gases from the locomotives. With the substitution of electricity the handsome train shed roofs would preserve their proper coloring and the light, graceful effect of their ironwork indefinitely. In the yards, moreover, the noisy exhaust of the switching engines would give way to the quiet hum of the motor—a change devoutly to be wished by the residents of the adjoining districts, who would at the same time be rid of the smoke and ashes that add their quota to the general inconvenience. When the approach to the terminal is in tunnel, as in many of the European cities and here on Manhattan Island, the purifying of the atmosphere due to such a change is too obvious for comment.

Before leaving this subject, it should be noted that an electric switching locomotive has this week made a successful trial on the Hoboken Shore Road, New Jersey. It has been built for hauling heavily loaded freight trains between the railroad terminals and the wharves of the transatlantic liners at Hoboken. The locomotive, which is eight-wheeled, develops a total horse power of 540 on four axles, each motor being of 135 horse power. The substitution of electric for steam traction will prove a great boon in the populous district affected by it.

FORETHOUGHT IN THE CONSTRUCTION OF DRYDOCKS.

The figures which have been given out respecting the new additions, costing $5,000,000, which are to be made to the dock system of Liverpool are very significant. The most striking feature is a new drydock which is to be 920 feet long, with an entrance 94 feet wide. Other contemplated improvements, whose total cost will be $16,500,000, include the enlargement of a dock which is now 475 feet long to a length of 1,000 feet and the construction of two others which will be respectively 620 and 630 feet in length. It is probable that, before determining the length of the new docks, the authorities consulted the owners of the transatlantic steamship lines which run to Liverpool, and that these vast dock dimensions have been determined by the great size of the ships which these companies have in prospect. The time is drawing near when the public will be looking for an answer on the part of the Cunard Company to the "Kaiser Wilhelm der Grosse" and the "Oceanic," and it would not be surprising if their next pair of ships had a deck length of from 725 to 750 feet. It is interesting to note in this connection that the new Liverpool dock could accommodate the White Star liner "Oceanic," 704 feet in length, with 216 feet to spare.

AROUND THE WORLD IN TWENTY-EIGHT DAYS.

When Jules Verne wrote his fascinating book, "Around the World in Eighty Days," he set a mark which the public has evidently agreed to use in noting any advance in the speed of circumnavigating the world. The writer aimed to show the very utmost that could be accomplished by the means of transportation of his day, and at the time the book came out it had all the possibility and improbability which characterized the other works of the author. In less than a quarter of a century, however, the feat of touring the world in eighty days has not only passed out of the realm of fiction into that of fact, but we find ourselves within a few years of the day when the ordinary tourist can make the trip in less than half of eighty days. This will be possible just as soon as the Trans-Siberian railroad is completed, or early in the twentieth century.

The Russian minister of communication, M. Chilkov, has stated that when the great railroad is opened the tour of the world can be completed in thirty-three days, the various divisions of the journey being covered as follows:

Bremen to St. Petersburg	1½ days.
St. Petersburg to Vladivostok	10 "
Vladivostok to San Francisco	10 "
San Francisco to New York	4½ "
New York to Bremen	7 "
Total	33 "

These figures are evidently based upon the actual running speeds of the various transportation lines, and an estimated speed of about 25 miles an hour from St. Petersburg to Vladivostok.

There is no doubt that even this time could be greatly reduced if the speed of the trains, and to a less extent of the ships, were not kept down by considerations of economy.

If any one were to set out to complete the circuit of the globe in the least possible time that modern transportation, in the shape of existing ships and railways, is capable of, irrespective of cost, it would be possible to reduce the estimate of M. Chilkov by five days at least.

In the figures given below it is assumed that the traveler has the services of the fastest existing ships on the ocean, and that the trains are run at the highest rate of speed consistent with the gradients, curvature and condition of the roadbed, in the various districts passed over. Thus the "Kaiser Wilhelm" would be available for the Atlantic passage, with her speed of 22·34 knots per hour, and a 20 knot ship is assumed for the Pacific passage. To maintain the high averages of the special trains chartered on the railroads, it is assumed that speeds of from 60 to 70 miles an hour would be maintained on the plains to compensate for time lost in crossing the mountain divides. What can be done with special facilities is shown by the fast runs which are frequently made in this country and in England.

The probable best time that could be made by chartering special trains would be about as follows:

Route.	Miles or Knots.	Speed per Hour.	Time in Hours.
New York to Plymouth	2,990	22·35 knots.	133·8
Plymouth to London	194	60 miles.	3·2
London to Moscow	1,800	50 "	36·0
Moscow to Tcheliabinsk	1,100	40 "	27·5
Tcheliabinsk to Vladivostok	4,500	37 "	121·6
Vladivostok to San Francisco	5,400	20 knots.	270·0
San Francisco to Omaha	1,864	40 miles.	46·6
Omaha to Chicago	493	50 "	9·9
Chicago to New York	998	60 "	16·6
			665·2

This gives a total of 27 days 17 hours for the whole journey. If 7 hours be allowed for delay in transfers,

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we get a total of 28 days, as the time which would probably be occupied by a special courier in making the entire trip around the world. This is what could be accomplished at the opening of the twentieth century. The rapid increase in steamship and railroad speeds which is now taking place makes it likely that before a quarter of the century has passed the same distance could be covered in three weeks or less, or in about the time that it took our forefathers, in the days of the stage coach, to travel overland from Boston to Washington and back.

NEW YORK CONSOLIDATED.

The opening of the year 1898 has seen the creation of a new metropolis which easily takes rank as the second greatest city in the world. If the ghosts of the founders of New Amsterdam could have joined the vast multitude which gathered on New Year's Eve in the City Hall Park to celebrate the birth of the new New York, they would have found themselves in a city which in size and wealth had grown far beyond the most sanguine dreams of its founders. In point of area and population old New York was rapidly climbing to the position of second city in the world, and the consolidation has simply hastened an event which was already within measurable distance.

Old New York covered an area of about 39 square miles and was popularly associated with Manhattan Island only. New New York covers an area of 320 square miles and includes five great boroughs: Manhattan, or that part of the original city comprised within the island of Manhattan; the Bronx, the part of old New York to the north of the Harlem; Brooklyn, including the city of that name and the districts between the city and the Atlantic Ocean; Queens, a district in itself larger than the old city, lying to the east of Brooklyn and between the Sound and the ocean; and Richmond, including the whole of Staten Island. The population of the city is increased from 2,000,000 to 3,388,000, giving it a place between London with 4,500,000 and Paris with 2,539,000. The next largest city in America and the sixth largest in the world is Chicago, with 1,438,000. The new city has 6,587 acres of parks and squares, 1,200 miles of streets, of which 1,002 are paved; 1,156 miles of sewers; 65½ miles of elevated railways; and 466 miles of surface railways. The shipping facilities of the new city are shown by the fact that it has over 350 miles of water front. The bonded debt is about $200,000,000, or equal to that of London, and the assessed valuation of real estate is about $2,500,000,000, that of London being over $5,000,000,000. The annual expenditure is about $67,000,000. The daily water supply, reckoned at 330,000,000 gallons, is over 50 per cent greater than that of London. If the present rate of progress should be maintained, it is likely that the coming century will not be half spent before New York will be both numerically and in point of wealth the metropolis of the world.

A NOBLE THOROUGHFARE.

The rapidity with which tall office buildings have been multiplying in the downtown districts of Manhattan Island has indirectly been the means of providing the consolidated city with one of the noblest thoroughfares in existence; for it was the necessity for increasing the water supply of these structures which led to the tearing up of Fifth Avenue to lay larger water mains, and the asphalting of the thoroughfare for a distance of over six miles. When the old mains were laid the calculations as to the city's requirements were based upon the necessities of buildings of from five to eight stories in height. The subsequent erection of so many fifteen to twenty-five story structures has, of course, greatly increased the consumption. To meet the demand and make a liberal provision for the future, the authorities have laid two 48-inch mains from Eightieth Street to Fourth Street, one line on each side of the street, and between these a subsidiary 12-inch water pipe has been laid. Previous to this the avenue was laid with Belgian blocks, and the unceasing din of traffic was a serious drawback to this handsome thoroughfare. The opportunity presented by the excavations was used for laying the whole six miles with asphalt pavement. The change in the appearance and quiet of the street is striking, and, no doubt, justifies the statement of General Collis, on his return from an inspection of European capitals, that in some respects, and especially in its electric lighting, Fifth Avenue is unsurpassed among the notable thoroughfares of the world.

LIVING WITHOUT A STOMACH.

In these days of remarkable achievements in surgery there seems to be almost no limit to success in operative procedure. In the matter of brilliant achievements along this line must be noted the operation performed by Dr. Carl Schlatter, of the University of Zurich, who has succeeded in extirpating the stomach of a woman. At present the patient is in good physical condition, having survived the operation three months.

Anna Landis was a Swiss silk weaver, fifty-six years of age, and, as all surgeons know, a capital operation at this time of life is attended with more than usual risk. From childhood she had abdominal pains, and medical treatment afforded no relief. On examination it was found that she had a large tumor. After a preliminary strengthening of the vital functions, she was operated upon, and the entire stomach was found hopelessly diseased. Dr. Schlatter conceived the brilliant idea of removing the stomach, which he did, uniting the intestine with the œsophagus. This done, there was then a direct channel from the patient's throat down through the intestines, while, in place of a stomach, was the end of the intestine—a length of about fifteen inches.

The abdominal wound healed rapidly, and three days after the operation nourishment by enema was discontinued and the patient was fed by the mouth. In a few days she could eat eggs, chopped meat and even a half of a chicken. This, however, appeared to have overloaded—we cannot say her stomach—her substitute for that organ, and she vomited, thus proving that this act, which is usually associated with the spasmodic contraction of that organ, can be considered special to it no longer.

A New York physician who saw the patient says that he was struck by her ruddy complexion and general alacrity. Her appetite was good; she did not eat much at a time, but ate every two or three hours.

In the lower forms of life the functions are little specialized, and in case of need other parts of the organism may be impressed into service to take the place of those which are missing; but with man it is different. When deprived of an organ which ordinarily performs functions essential to life, he dies. The recent operation on the Swiss woman throws over our preconceived and stereotyped notions as to the vital organs. The stomach has long been supposed, in a certain sense, to govern the other functions of the body, but its physiological place in the human economy is threatened and the work done by this autocrat is now performed by the intestines, which, in this case, have assumed the whole burden of digestion, and, to all accounts, they are performing their good offices in an exemplary manner. It is not beyond the limits of possibility that there will be a future enlargement of the digestive tract to form a food pouch, and replace, in some degree, at least, the missing organ. Such an incident tempts one to speculate on the validity of many opinions we now hold regarding the physiology of the vital functions. There is a limit somewhere, but medicine and surgery are constantly pushing it farther away and the end is not yet.

Owing to the unique nature of this daring and brilliant operation, we have published a full account of the case in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

JOINT KLONDIKE RELIEF EXPEDITION.

The arrangement effected December 30, says The New York Times, between Mr. Sifton, the Canadian Minister of the Interior, and the War Department contemplates that the relief expedition shall be executed jointly by the United States Army and a force of the Mounted Police of Canada, which constitutes the military arm of the Dominion. The United States force will proceed with the relief stores to Skaguay, where they will be joined by the Canadian Mounted Police, about forty in number, and the two forces will then proceed together to the points where the relief is to be distributed.

The determination as to Skaguay is, however, still open. The Canadian officials concede much latitude to the American authorities in the actual distribution, recognizing that the expedition is fitted out on this side, although a considerable part of its work will be done on the Canadian side of the border. No duties will be imposed on the stores carried by the relief expedition.

Mr. Sifton also held a conference with Secretary Gage and discussed the unsatisfactory condition of customs regulations along the border and at coast ports where goods are received by one country for transportation to the other country. It was the mutual feeling that an improvement of the system could be made, and negotiations are in progress which are hoped to effect changes advantageous to both sides.

Mr. Sifton says that the only practicable route to Dawson City is what is known as the White Pass, or commonly called the lake route, commencing at Skaguay, on Lynn Canal. He stated that they have eighty-five men in the territory, and expected to have fifty more at Skaguay on or before January 5. They have thirty tons of supplies now stored at Skaguay for transportation over the pass.

The Canadian authorities have a post at Lake Bennett, another at Tagish, at which latter place twenty men are stationed; another post at White Horse Rapids, and two posts intervening between the latter point and Fort Selkirk.

It is the intention of the Canadian government to have a detachment of two hundred and fifty men in the territory within the next thirty days. Their detachment will be ready to leave Skaguay on January 15, but the minister has kindly consented to hold the expedition, that it may accompany the expedition of the War Department, which will leave Skaguay on or before February 1. The minister was over the pass in October last. He stated that the government would be very glad to grant the expedition the use of its posts on the route and all other facilities over the territory.

A YEAR'S SHIPPING RECORD.

The Custom House figures on the shipping of the Port of New York for 1897 show, says The New York Times, that there were 4,614 arrivals of vessels from foreign ports, 7,095 from Eastern domestic ports, and 3,798 from Southern domestic ports. Of the foreign, 2,313 were British, of which 1,667 were steamships; 952 were American, of which 323 were steamships; 517 were German, of which 444 were steamships; 281 were Norwegian, of which 242 were steamships; 149 were Dutch, of which 138 were steamships; and 115 were French, of which 111 were steamships.

Of sailing vessels from foreign ports there were 94 entries of ships and 131 of barks, 40 of brigs, and 381 of schooners flying the British flag; flying the American flag, 58 ships, 67 barks, 26 brigs and 478 schooners.

There were 1 Nicaraguan steamer, 1 Greek steamer, 2 Haitian brigs, 1 Hawaiian ship and 2 Hawaiian barks, 1 Brazilian steamer, and 2 barks carrying the same flag; 20 Austrian steamers, 23 Portuguese steamers, 31 Danish steamers, 53 Belgian steamers, 58 Spanish steamers, and 4 Italian.

The coastwise trade confined under the navigation laws to American bottoms shows that of the 7,095 vessels from Eastern ports 6,564 were schooners, while only 503 were steamers. The others were sailing craft of various rig. The Southern trade shows a large proportion of steamers, there being 1,483, as compared with 2,246 schooners, the remaining 69 vessels being ships, barks and brigs.

The disparity in proportion of the steamers in the coastwise trade with the East is accounted for by the fact that the Sound affords a sheltered course for steam vessels of a class which do not enjoy the dignity of a place in the shipping records of the Custom House. These are the Sound steamboats, which carry on so large a part of Eastern traffic.

The December reports of arrivals show 358 vessels of all classes and nationalities from foreign ports and 859 from domestic.

THE CONDITIONS OF MODERN NAVAL WARFARE.

In the late war between China and Japan, naval warfare on a large scale and under modern conditions was for the first time fairly exemplified, says The Medical Record. Without doubt, if the Japanese had met foemen more worthy of their steel, the lesson taught from a medical and surgical point of view would have been even more instructive. However, quite enough facts have been gathered to demonstrate plainly that a complete revolution has been effected in the methods of naval warfare. Not only has it been shown, as might have been anticipated from the nature of the new conditions, that the wounds received were of a more fearful and generally of a different character, but it also has been clearly shown that the shock to the nervous system from the noise and vibration was terrible—in some instances, indeed, fatal. Dr. S. Suzuki, fleet surgeon in the imperial Japanese navy, read before the International Congress at Moscow a paper treating of the wounded in naval battles between Japan and China, together with some notes on the sanitary conditions of the navy during the war. This paper has just been published in pamphlet form. Many interesting details are given. The principal seat of injuries appears to have been the head, while the hurts causing the largest number of deaths were those affecting the larger parts of the body. This was a natural result, because in the majority of these cases at least one-third of the body was burned and in some wholly destroyed. It is pointed out that in sea fights most of the wounds are in the head, and in land fights in both extremities. The explanation is that in land fights soldiers as a rule are injured only by shells and bullets, whereas in sea battles all materials around the combatants, as ship planks and rigging, etc., being blown to pieces by the bursting of shells, increase the causes of injury. The antiseptic treatment, which was of course pursued, seems to have been attended with most satisfactory results. No infectious diseases of wounds occurred, with the exception of one fatal case of erysipelas. There was one case of burns leaving remarkable keloid scars. The sanitary condition of the Japanese navy was throughout the war excellent. Venereal disease and its sequels supplied 37·69 per cent of the total number of cases of disease. Diseases of the respiratory system numbered 9·01 per cent; diseases of the digestive system, 10·09 per cent; and skin diseases 8·91 per cent. There were 167 cases of malarial fever, 4·79 per cent of which were fatal. But 3 cases of cholera occurred in the Japanese navy. Of the 43 cases of kak'ke, 3 were fatal, the ratio of cases per 100 of force being 0·21. Of the total number of persons dying at sea during the war, 150 were killed in action and 177 died of disease.

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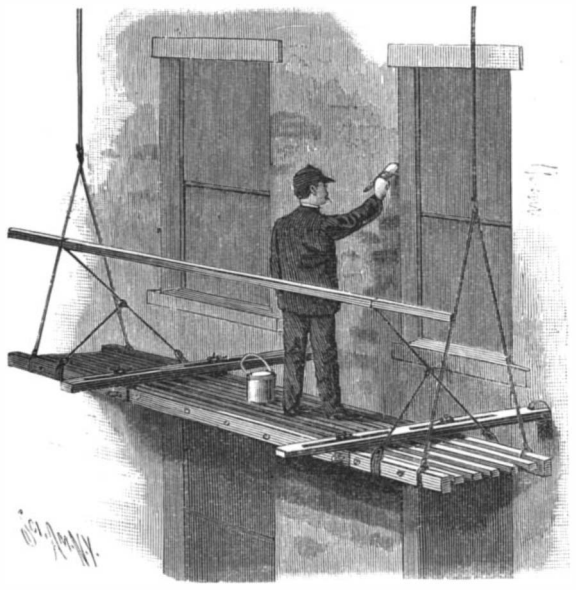
A SWINGING SCAFFOLD IMPROVEMENT.

In using swinging scaffolds it is generally necessary to provide cross-bars which project inward from the inner edge of the scaffold to engage the surface of the building, and hold the scaffold out at a convenient working distance. The invention illustrated herewith represents an improved spacing and guiding device of this description, in which the cross-bar is made adjustable upon the scaffold, both lengthwise and also to vary the projection of the bar, regulating the distance at which the scaffold is held away from the building.



CODY'S SCAFFOLD.

The improvement has been patented by Martin Cody, No. 106 East 109th Street, New York City. It comprises a cross-bar in which are longitudinal slots and a clamp having U-shaped arms adapted to embrace the side-bars of the scaffold, a bolt passing through one of the arms being adapted to engage the side-bars, while a bolt secured to the bend of the clamps passes through the slots in the cross-bars, whereby the cross-bars may be adjusted upon the scaffold without loosening the attachment of the clamps to the side-bars. Two of these U-shaped clevises or yokes are provided for each cross-bar, and the inner ends of the bars are provided with rollers to engage the building. Any required adjustment is easily effected as the scaffold is shifted to different places upon a building, or as it may be necessary to have the cross-bars in contact with the building and not projected opposite a window.

THE COMBUSTION OF SMOKELESS POWDER.

The popular idea of an explosive is a substance which is capable of instantaneous combustion in a confined space to which no air is admitted. Although the term burning is freely used in speaking of powders, it is little understood that the various explosives have different rates of combustion, entitling them to be termed either slow burning or quick burning or detonating, as the case may be. As far as our senses are able to inform us, all explosives are instantaneous, and it would seem as though the solids were converted into gases in a literal instant of time.

As a matter of fact, however, there is a difference in the rate of combustion which is sufficient to divide explosives broadly into two classes, those which are detonated and those which are quick burning and slow burning. Detonating explosives are those in which the explosive is consumed simultaneously, or practically so, throughout its entire mass by what is called a wave action. The generation of gas is so complete and instant as to produce a disruptive or shattering effect, which renders such explosives useful for blasting purposes, but unfits them for use in rifles or artillery.

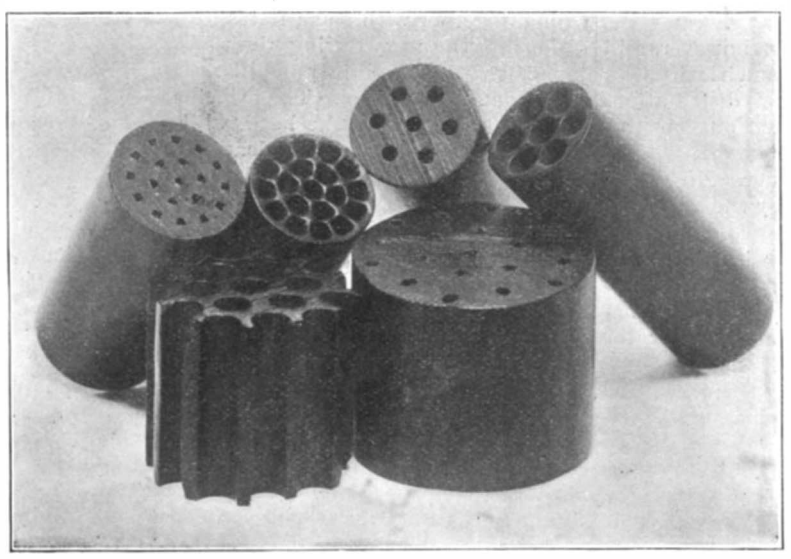
In the gunpowders as distinguished from detonating explosives, the combustion takes place upon the surface of the solid particles composing the powder, and an appreciable period of time is consumed in their combustion. At the moment the powder is ignited, the consuming flame attacks the whole surface of each grain, whether the grain measures a cubical inch in bulk, as in the powders of heavy guns, or whether it be the size of a pinhead, as in the common black powder.

The early black powder, though it was not a detonating powder, was consumed with such rapidity that the whole of it was converted into gas before the shell had moved forward twelve inches in the gun, and the expansive force of the gas then served to further accelerate the shell during its travel through the remainder of the bore. This brought a very high initial pressure upon the gun and prevented the use of sufficiently large charges of powder to give high velocities.

It was found, however, that by compressing the powder into cakes the total area exposed to the flame was reduced, and hence the time of combustion was prolonged. The result was that the pressure was produced gradually during the travel of the shell toward the muzzle, the pressure being spread out, as it were, over a larger area of the bore. The resulting velocity of the shell was the same, the difference in the action of the powder being the same as that between a blow and a push, but there was the added advantage that the initial or maximum strain on the gun was less. The ideal powder would burn at such a rate that sufficient gas would be generated to maintain a constant pressure behind the shell throughout the whole length of its travel through the gun. At the same time it should be consumed at such a rate that no unburnt powder should escape with the gases.

The smokeless powders, because of the small quantity of solid products of combustion and the great volume and high temperature of the gases, enabled the artillerist to secure velocities far in excess of those obtained by the use of the old powders. Moreover, smokeless powders lent themselves to the formation of powder grains which would insure the very best control of the combustion of the powder. We present illustrations of the Maxim-Schupphaus smokeless powder, which is formed into multi-perforated grains, whereby the burning area is regulated so that only a desired initial pressure is obtained, and the powder is consumed with such increase of burning area as to maintain a practically equal pressure behind the projectile throughout the gun.

It is evident that solid cylinders of powder would decrease in area as they burned, and there would be a corresponding decrease in the amount of gas given off. If, however, the cylinder burns up on the interior by means of suitable perforations, the burning area and therefore the volume of gases produced will increase. The accompanying engraving is from a photograph of some unburned and partially burned grains of Maxim-Schupphaus smokeless cannon powder. The partially burned grains were picked up in front of the gun after some experiments in firing powder from a gun too small for the grain of powder employed. They illustrate the action of the combustion of this powder in the gun and demonstrate that the powder is consumed with the effects claimed by Mr. Hudson Maxim.



MAXIM-SCHUPPHAUS POWDER BEFORE AND AFTER FIRING.

It will be seen that two kinds of perforations are employed, those in the cylinder to the right being circular and those of the opposite cylinder being quadrilateral in section, with two sides radial to the center of the cylinder. The latter form was adopted to secure a more even and complete combustion of the powder. That this is done is shown by comparing the bulk of the solid sections which remain in the two types of powder grain.

We subjoin the results of tests carried out by the United States Navy at Sandy Hook and Indian Head proving grounds. With 11·75 pounds of this powder fired in a 5-inch rifle of the United States Navy a velocity of 2,556 feet per second was obtained with an initial powder pressure of 34,900 pounds per square inch. With 11 pounds of the same powder fired in a 4·7 inch breech-loading field gun the high velocity of 2,839 feet per second was obtained with a powder pressure of 37,756 pounds per square inch. The powder consists almost wholly of guncotton and contains about 9 per cent of nitroglycerine.

THE GREENVILLE TREATY.

One of the most interesting publications which the Bureau of Ethnology has ever published is Mr. Mooney's monograph entitled "The Ghost Dance Religion and the Sioux Outbreak of 1890." Even the layman when he examines this splendid volume cannot but feel proud of the Bureau of Ethnology, and, after considering this and other publications of the government, it is little wonder that foreign scientific journals speak of them in the highest terms. One of the illustrations of Mr. Mooney's monograph is the Greenville Treaty Medal, of which, by the courtesy of the director, we are enabled to present an engraving showing the obverse and the reverse of the medal.

By treaties made in 1768 with the Iroquois and Cherokee Indians, the two leading confederacies in the East, the Ohio and the Kanawha had been fixed as the boundary between the two races, the Indians renouncing their claims to the seaboard of the Delaware and the Susquehanna, while they were confirmed in their possession of the Alleghany, the Ohio and the great Northwest; but the restless borderer would not be limited, and encroachments on the natives' domains were constantly being made, resulting in a chronic warfare which kept alive the spirit of resentment. The consequence was that, in the final struggle of the Revolution, the Indians ranged themselves on the British side. When the war ended, and a treaty of peace was made between the new government and the old, no provision was made for the red allies of the king and they were left to continue the struggle single handed. The Indians claimed the Ohio country as theirs by virtue of solemn treaties, but pioneers had already occupied Western Pennsylvania, Western Virginia and Kentucky and were listening with eager attention to the reports brought back by adventurous hunters from the fertile lands of the Muskingum and the Scioto. They refused to be bound by the treaties of a government they repudiated, and the tribes of the Northwest were obliged to fight to maintain their territories. Under the able leadership of Little Turtle, they twice rolled back the tide of white invasion, defeating two of the finest armies ever sent into the Western country, until, after twenty years of unceasing warfare, crushed and broken by the decisive victory of Wayne at Fallen Timbers, their villages in ashes and their cornfields cut down, the dispirited chiefs met their conqueror at Greenville in 1795 and signed away the rights for which they had so long contended.

GREENVILLE TREATY MEDAL, OBVERSE AND REVERSE.

By this treaty, which marks the beginning of the end with the Western tribes, the Indians renounced their claim to all territory east of a line running in a general way from the mouth of the Cuyahoga, on Lake Erie, to the mouth of the Kentucky, on the Ohio, leaving to the whites the better portion of the Ohio Valley, including the hunting ground of Kentucky. The Delaware, the Wyandotte and the Shawana, three of the red tribes, were almost completely shorn of their ancient inheritance and driven back as refugees among the Miami. Our engraving shows the Greenville Treaty Medal of 1795.

The original silver medal presented by George Washington to Red Jacket was recently sold in New York. It closely resembles the medal shown in our engraving, only the date is 1792. It was presented to Red Jacket during Gen. Washington's third visit to Philadelphia. Upon the death of the Indian chief it fell into the hands of James Johnson, his successor, and it finally came into the possession of E. S. Parker, an educated Seneca Indian, and at his death it was sold by his widow.

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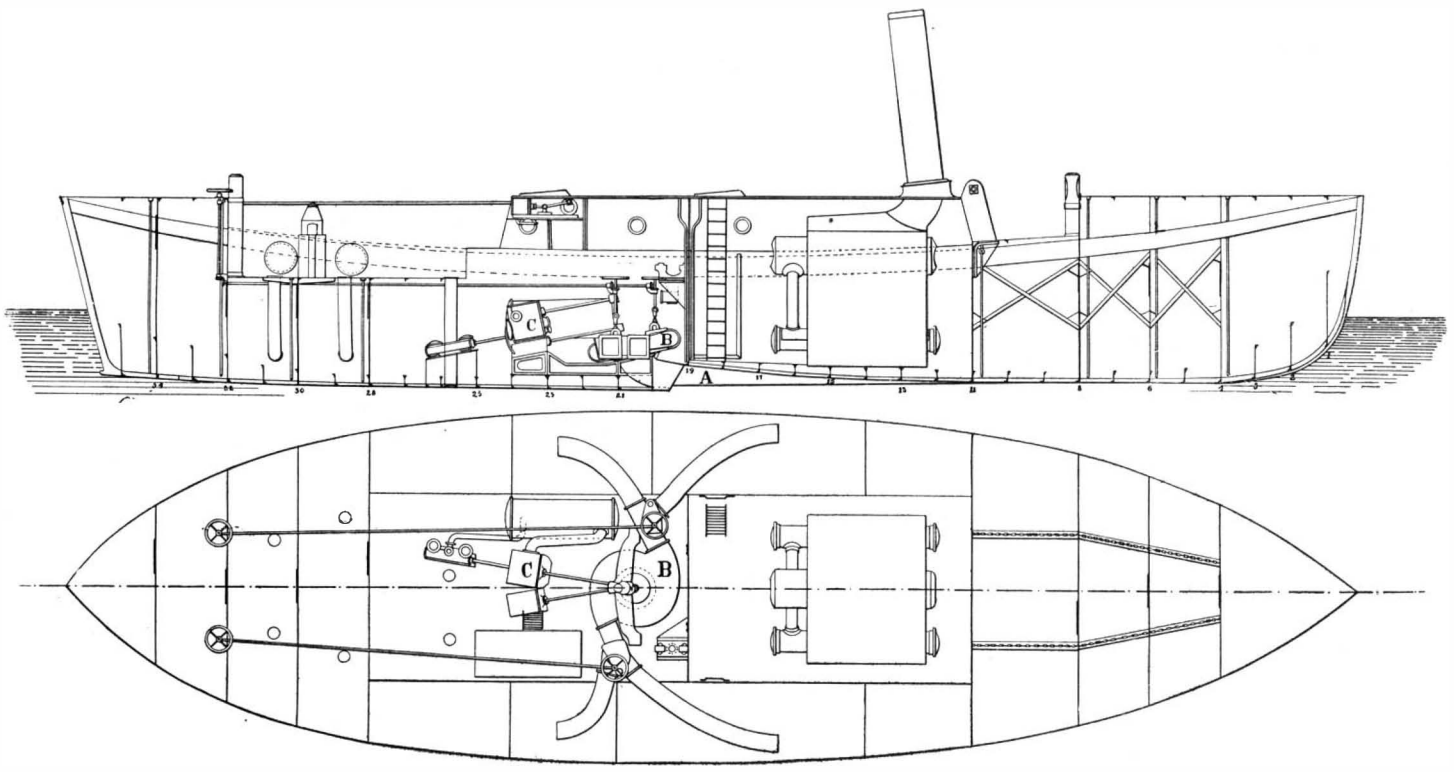
A HYDRAULIC LIFEBOAT.

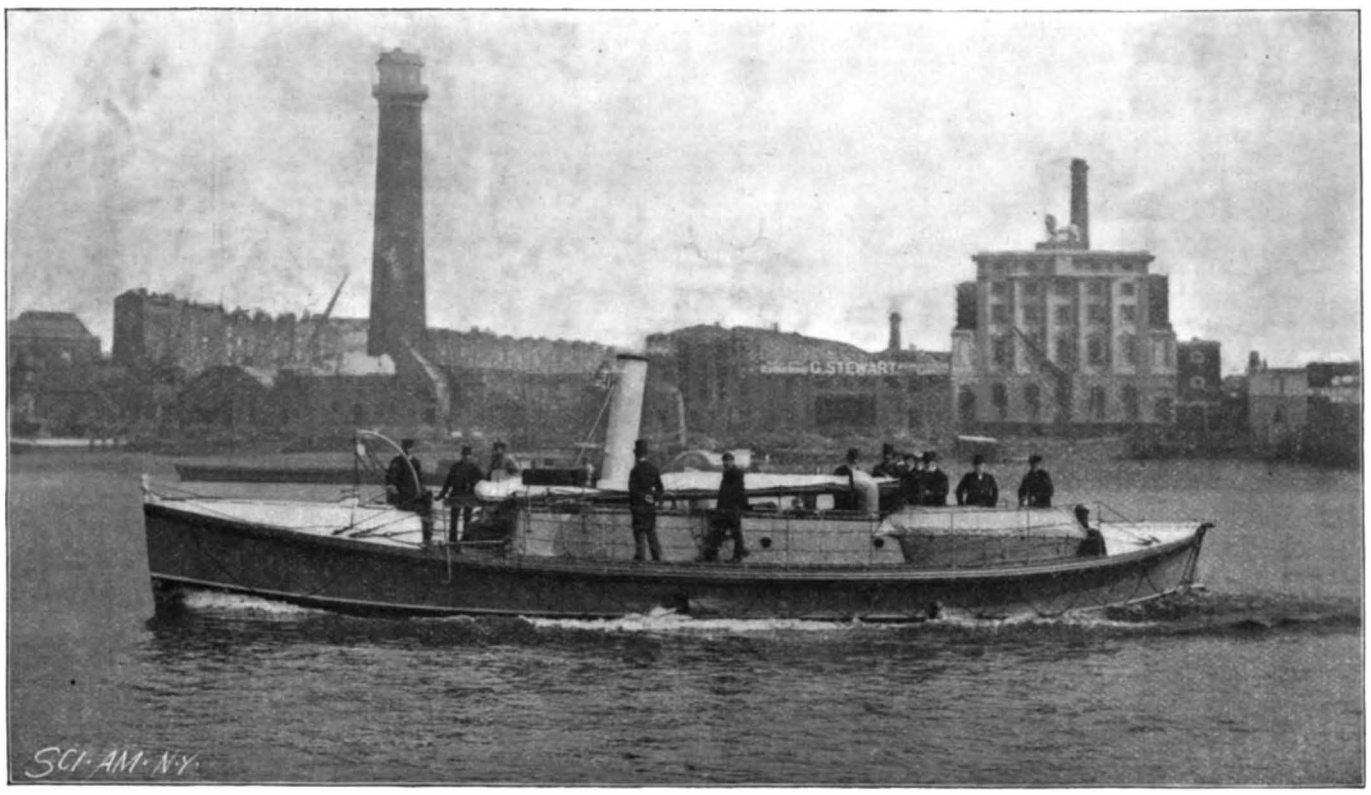
We present illustrations of one of the few successful hydraulically propelled boats which have been constructed in recent years. Most of our readers will remember the attempts which were made years ago at hydraulic propulsion by means of a jet of water driven at high pressure from a three-quarter inch nozzle at the stern of the boat. The attempt in question was not successful for obvious reasons. Since that time hydraulic propulsion has been successfully achieved by enlarging the area of the discharge and forcing through it a large volume of water at a moderate pressure. This system was applied some years ago to a hydraulic lifeboat named the "Duke of Northumberland," which was constructed by Messrs. Green, of Blackwall, the machinery being supplied by Messrs. Thornycroft, of Chiswick, the well known builders of torpedo boats. This system of propulsion was not applied with any idea of economy, but with the object of providing a steam-propelled boat which should not have any exposed propeller, which might be damaged by the wreckage of vessels. Since she was put actively to work, the "Duke of Northumberland" has rendered excellent service at Harwich and also at New Brighton, where she is at present stationed.



LONGITUDINAL SECTION AND PLAN OF "THE QUEEN" SHOWING ENGINES C, CENTRIFUGAL PUMP B, SUCTION A, AND THE DELIVERY PIPES FOR THE HYDRAULIC JETS.

"The Queen" is the second lifeboat of this type to be built and she takes her place as one of the fleet of the Royal National Lifeboat Institution. Her dimensions are as follows:

Length over all, 55 feet; width of hull, 13 feet 6 inches; breadth on deck, 16 feet; the deck being carried out considerably beyond the sides of the hull so as to form sponsons of the kind with which we are familiar in American river steamers. The sponson deck is very solidly constructed and acts as a fender for the hull when the boat is taken alongside a wreck. It also affords protection to the jet orifices in the sides of the boat.



HYDRAULIC LIFEBOAT "THE QUEEN" CONSTRUCTED FOR THE ROYAL NATIONAL LIFEBOAT INSTITUTION.

The hull was designed by Mr. G. L. Watson, best known in America as the designer of the "Thistle" and the "Valkyries," challengers for the America cup. It is built entirely of steel and is fully subdivided into watertight compartments. In the after part of the boat is a large open cockpit, from which the steering is done. The cockpit is made watertight with non-return relieving valves, which allow any water which may be shipped to flow out immediately. The rudder projects considerably below the bottom of the boat to enable it to take hold of the water in a choppy sea. The steering is greatly assisted by the method of hydraulic propulsion, as will be explained later in the article.

The boat is driven by engines, C, of 200 horse power, which are direct connected to a centrifugal pump, B, which is placed approximately horizontally near the bottom of the boat. The pump is 2 feet 6 inches in diameter, and, when running at full speed, it makes 450 revolutions per minute. The cylinders of the compound engine are 8½ inches and 14½ inches in diameter, with a common stroke of 12 inches. Steam is supplied by a Thornycroft water-tube boiler placed in a closed compartment forward of the engine. The pressure at the boiler is 140 pounds to the square inch. The water is drawn into the pump by means of an intake, A, formed by a break in the skin plating, which is formed in the shape of a scoop. The outlet and inlet passages are short, being made so with a view to carrying as small a quantity of water as possible. The go-ahead outlet is located just below the water level and the go-astern outlet just below the sponsons. In whatever direction the boat may be traveling, the centrifugal pump is always turning one way, and the reversing of the boat is accomplished by directing the flow of water either ahead or astern, as the case may be. After the water has passed through the pump it passes to either side of the boat, and each delivery pipe is divided into two branches, which enable the water to be directed either toward the bow or the stern by means of two sluice valves, which are located at the point of division of the outlet passage. These valves are operated by means of hand wheels, which are located conveniently within reach of the coxswain's hand in the afterpart of the cockpit. This gives the coxswain a remarkable control of the boat. If he wishes to make a sharp turn to port, he will direct the port race from the pump ahead, while the starboard jet will be kept going astern. The action is somewhat similar to that of a twin screw vessel, but more effective, owing to the fact that the jets emerging amidships give a greater turning moment than is afforded by screws located near the keel at the stern. Another curious feature is that the boat can be stopped without stopping the engines, by placing the valves so that they divide the water delivered from the pump between the go-ahead and the go-astern positions. On her trial trip the boat showed a speed of 8·85 knots per hour. As was to be expected, the boat runs with great steadiness and practically no vibration, and there is only a slight throbbing movement noticed, which is, of course, due to the momentum of the reciprocating parts acting in a fore and aft direction.

It will be noticed that, for the power developed by the engine, the speed is low; but, as we have already stated, the hydraulic propulsion is not adopted for motives of economy, but because of its fitness for the particular class of work which the lifeboat has to accomplish. The ordinary propeller would be simply out of the question, because of the certainty of its being fouled by the ropes and wreckage which is usually floating alongside a stranded ship. The intake of the hydraulic engine is built entirely within the hull and is protected by gratings; it is, therefore, well adapted for use where the sea is encumbered with wreckage and floating spars. Moreover, the short, steep seas which a lifeboat, in putting out, has to encounter, would cause screw propellers to race excessively; whereas the hydraulic propulsion is not affected by rough water.

The lifeboat is provided with a heavy steel wire hawser 100 fathoms in length. It is carried on a reel located in the cockpit. The boat also carries a steam capstan which will prove of inestimable value in the work of the boat. At the conclusion of the speed trials interesting experiments were carried out to determine the turning capacity. A life buoy was thrown overboard while the vessel was running at full speed, and the jets were at once delivered in the go-astern direction. It took just one minute to recover the buoy. For purpose of comparison, the time was taken in recovering the buoy with the jets going ahead and the rudder put hard over. It took exactly the same time to recover the buoy as in the first place. The draught of the lifeboat, when all gear, stores, fresh water and thirty-nine persons are on board, is about 3 feet 3 inches, and at this draught the displacement is about 30 tons. We are informed by Messrs. Thornycroft & Company, by whose courtesy we are enabled to present the illustration and particulars, that they are now contemplating a steam lifeboat driven by a screw turbine propeller, which will secure all the advantages of hydraulic propulsion, but which will give an equal speed for about fifty per cent as much power as is required to drive the centrifugal pump.

RECENTLY a bust of Michael Faraday was unveiled at the Michael Faraday Board School, at Walworth. The bust was presented by the managers of the Royal Institution, and is a copy of the original bust executed by Matthew Noble. Sir J. Crichton Browne, F.R.S., and other representatives of the Royal Institution, were in attendance.

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Exhibition of Kodak Photographs.

The introduction ten years ago by the Eastman Kodak Company of a new system of roll holder or film photography, when the word "Kodak" was first applied to a camera and the phrase, "You press the button, we do the rest," became popular, is now fittingly celebrated by a singularly large and interesting exhibition of Kodak pictures, going on from January 4 to January 15 at the Academy of Design in this city, corner of Twenty-third Street and Fourth Avenue, and is well worthy of a visit.

The exhibition combines work sent in in answer to a number of competitive competitions gotten up by the Eastman Company last year, besides several loan exhibits sent upon invitation by a number of well known art photographers and also by members of the royal family of England. The pictures have been exhibited in London and are now put on view in New York as examples of the latest progress in film photography. The excellence of the display, the prominence of many of the contributors, make it very attractive to all interested in photography.

The south (largest) room is devoted mainly to enlargements on the Eastman bromide paper by notable photographers and the royal family, some of which, in tone and color, simulate etchings to a remarkable degree. The latest method of softening masses of light and shade in enlargements is to place over and in contact with the sensitive sheet an ordinary fine open meshed bolting cloth, such as is used in flour mills, during the exposure. While the dots and spaces produced by this method are observable on close inspection of the print, they disappear when viewed at a little distance.

The magnitude of several of the enlargements also demonstrates the freedom from grain in the special transparent film used as the basis for the sensitive emulsion, as well as the excellence of definition of the lenses employed.

The west hall is filled with large frames of prize Kodak and pocket miniature photographs, all of excellent uniform quality.

The north hall contains loan photographs and larger sized direct pictures, while the east gallery is devoted mainly to the industrial branch of film photography and to lantern slides and transparencies. Here were to be seen specimen prints toned in several different ways, negatives and transparencies produced directly by the solarization or reversal of the image method, remarkably well executed X ray, large photographs, and specimens of the film as prepared prior to the coating of the sensitive emulsion.

There were also examples of the Eastman transfer bromide paper, by means of which the developed image can be transferred to porcelain, glass, linen, silk, and other articles.

The pictures were neatly framed and the several halls appropriately draped. As a whole the exhibition may be considered a success, not only as illustrating the art and scientific possibilities of film photography, but also the remarkably rapid growth and extension of a purely American industry devised by Americans keen enough to comprehend the popular demand for simple, inexpensive picture-taking apparatus and appliances.

Common Errors About Snakes.

BY NICOLAS PIKE.

Much has been written recently in relation to snakes, when in danger, receiving their young into the esophagus and retaining them until danger is over. This has been denied in strong language by many naturalists who seldom think it worth while to study the biology of this interesting class of animals. It appears strange that at this late day the wildest superstitions are still extant with regard to reptile life. There is one reason that may account partly for it. Nine out of ten persons who meet a snake either kill it or run from it. Now if a little trouble were taken to watch some of their habits, they would soon lay aside their erroneous ideas.

I intend to show in this article that not only one species of snakes, but many, have been known positively to care for their young in this manner. I shall also try and correct many errors concerning snakes. It is a very difficult matter to eradicate superstitious ideas and foolish errors, when universally engrafted upon the public mind. Many of these errors have become fixed among the ignorant, and even among some that are educated.

That snakes receive their young into the esophagus when they are in danger is a well known fact. More than forty years ago Sir John Richardson published an account of a rattlesnake that he saw take a brood of young ones she attracted by her rattles, and they darted into her mouth, which she held wide open. The moment the little ones heard the warning, they disappeared into her esophagus.

Prof. Brown Goode, Curator of the Smithsonian Institution, Washington, in a paper read by him before the American Association for the Advancement of Science, proved that the performance was not an uncommon one.

Col. F. W. Prince, of Hartford, Conn., says he saw a snake, probably an adder, about whose head and body her young brood were disporting themselves. Instantly the mother snake opened wide her mouth and down her throat ran the baby brood, one on the tail of the other. Dr. Edward Parker states that when in Paraguay he saw seven young rattlers run into the mouth of the old one. He secured them, and they are now in the collection of the National Museum, Washington.

Thomas Proctor, lawyer, naturalist, and gentleman, whose veracity is undoubted, informed me that he has seen the common garter snake take her young into the esophagus and, after retaining them for some minutes, has seen them come out again.

I have observed this habit in a number of species, including the rattlesnake, the common adder, Heterodon platyrhinos, two species of garter snakes, Eutania sirtalis and saurita. In the year 1842 I made a tour on foot round Long Island, in order to gain a knowledge of its fauna and flora. A naturalist of distinction accompanied me on the trip. At this early period snakes, including the rattler and copperhead, were there not uncommon. The striped pine snakes and sand adder were very numerous. One day while in camp I observed, very near my tent, a striped snake with a number of little ones around her. I called my companion, who was near, to come and see the pretty sight. As he came forward the snake became frightened and made a blowing noise, which the young understood, for they quickly gathered near the head of the mother, who opened her mouth wide, and they all disappeared into her esophagus. I quickly seized her by the neck and secured the whole family, seventeen in all. I kept them a week and then gave them their liberty. During the period of confinement I had the pleasure of seeing the mother protect her young several times in the manner above stated. Prof. Brown Goode has accounts like the above from more than one hundred different sources. Of these, sixty-seven observed the young dart into the old snakes' mouths. Twenty-two noted the means of communication that warned them of danger, which was either a blowing, a click, a rattle, or whistle. Five witnesses saw the young go in and come out again, and one observer saw the act repeated on several successive occasions. Why should we disbelieve that the snake take their young into the esophagus, when it is well known that fish do the same thing? The fish in Panama called the arius, according to Agassiz, carry their young in this way. While at the Seychelles group of islands, Southern Africa, it was my custom to bathe in the ocean every morning. On one occasion, in company with an officer of the English army, we observed a fish, which I thought to be "Laffe volant," lying quite motionless near the bottom, in shallow water. Numerous small fish, two inches in length, were swimming around the larger fish's head. When we disturbed what proved to be the mother, she opened her mouth wide and instantly the young disappeared down her throat. At first we thought she had devoured them, but in a few minutes they all appeared, swimming round the head of the mother as before. Again when disturbed she did the same thing. We tried the experiment with a number of individuals with same results. We thought at the time we had made a great discovery. In speaking of the circumstance to some friends, we found it was well known to those living in the island.

There is a fish in the Amazon River, South America, that has been observed to care for her young in the same manner. The fish is called the "studis." There are many animals that have a similar habit. Among the reptiles there is a lizard, native of South Africa, I have observed do this. I could add largely to the above, but space will not admit in this article.

The common error, which is almost universal, is that snakes bite. Snakes do not bite! Their jaws are connected only by a cartilage, are not hinged, and cannot be brought together with any force. The poisonous snake strikes from its coil, throws its head and body forward, and strikes or hooks its fangs into the object aimed at. The entire work is done with the upper jaw, the lower jaw having nothing to do with it. The serpent does not swallow its prey; but slowly draws itself over the creature it devours. It is enabled to do so by the elasticity of the skin and the extraordinarily loose condition of the teeth-bearing bones of its fangs. As for a snake depositing a thick slime all over its prey before swallowing it, it is a mistake. The tongue does not carry moisture enough to do this, but when once inside the animal there is an abundance of saliva. The tongue is looked upon as a sting, and the common expression is "Look out for its sting!"

The tongue is a mobile, extensile organ of both touch and taste. So far from being a sting, the delicate implement is of the greatest use, and expresses fear, anger, or pleasure; also when testing any objects of food. This we have often proved whenever a different kind of food was given. There is no doubt but that the tongue of a snake is very important to its owner, as the slightest injury even to its tips generally results in the snake's death.

That Snakes Fascinate Their Prey.—The notion formerly entertained that snakes fascinate their prey is superstitious and now exploded.

Shedding of the Skin.—The general opinion is that snakes shed their skin once a year. Snakes do not shed their skin or hide, only the cuticle. I have known this to take place four or five times in one year.

As snakes have no ears, they are supposed to be quite deaf. Snakes are very sensitive to sound when there is a vibration in objects in contact with their bodies. It is said that they have also an appreciation of sound through the delicate nerve of the tongue.

Many positively assert that snakes are not fond of music. As a rule, snakes are fond of music. I have had them wriggle about, erect their heads and bodies, to the sound of the piccolo and flute. Loud music, such as the cornet and bugle, frightens them. While living in the East, I was frequently invited by friends to accompany small hunting parties to the forest. On one occasion I had been out all day, and our bungalow was left in charge of a servant. On our return, we were informed that a large and dangerous serpent had been seen to ascend to the thatched roof and secrete himself there. A fakir was sent for and came immediately. Seating himself, with a companion, on the floor, in the center of the house, he commenced to play an instrument similar to a clarinet. Soon the snake made his appearance, first showing its head only; gaining confidence, he soon moved to a position directly over the head of the musician, letting himself down full length, holding on a minute by its tail, then dropping down to the floor and coiling up directly where the men were seated, elevating its head and body about twelve or fourteen inches, swaying backward and forward, keeping time to the music for some minutes, when the musician's assistant placed a basket over its head and secured it. Snakes are very timid creatures, and always try to avoid man when they can do so; but when cornered, and find that they cannot escape, will turn upon him. I have had small garter snakes do this, and have always given them their liberty for displaying so much courage. They are easily frightened, but if handled carefully, will soon become very tame and familiar. Although I have studied them for many years scientifically, I am always learning something new about them—some new disclosure in their life history. So it is in all branches of nature; therefore, it becomes very important to note down carefully observations for future reference and comparison. The proper way to study natural history is in the field. There are few works on natural history that are professionally treated, and many of these are unsatisfactory. Those who have been obliged to examine carefully, in the hope of collecting original observations, statements of facts worthy of repetition, or remarks properly illustrative to obtain the information desired, have been sadly disappointed. There is no doubt that many naturalists of the present day study natural history improperly. A collection of stuffed bird skins, sea shells, reptiles in alcohol, scientifically arranged, with Latin names, and locality, is all that is required. Biology is ignored! I am not much surprised at the superstition which many people entertain about snakes. Most people have great antipathy toward them, and the hand of man is almost universally raised against them. With the exception of the poisonous kinds, the snake should be protected as a friend to mankind. They destroy an immense amount of rats and mice, and are truly a friend to the agriculturist. Many people have erroneous ideas which were instilled into their minds in childhood, especially concerning the serpent, and it is a very difficult thing to eradicate such ideas of long standing. It seems incredible that such things exist, and are countenanced in this enlightened age, especially by those who profess to be educated. But such is a fact; and the object of this article is to correct some of the most glaring of these mistakes.

Alfred Nobel's Will Proved.

The will of the late Alfred Nobel, the Swedish chemist, an expert in high explosives, who died at San Remo, Italy, on December 9, 1896, has been proved. The personalty is valued at $2,170,465.

About half the estate goes to relatives and the remainder is invested, the interest to be divided annually into five prizes of about $10,000 each. Prizes one, two, and three are to be awarded to the persons making the most important discoveries in physics, chemistry, physiology or medicine.

Prize four is to be given to the person making the best literary contribution upon the subject of physiology or medicine, and prize five is to be awarded to any person who has achieved the most or done the best things looking to the promotion of the cause of peace throughout the world.

These prizes, which are all open to any persons anywhere in the world, will be awarded by the various Swedish academies, except the prize for the propagation of peace, which is left in the hands of a committee to be elected by the Norwegian Parliament.

ACETYLENE can be neither manufactured nor sold in Great Britain now save by express permission of the Home Secretary, the prohibition being made in a recent Order in Council.

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Correspondence.

Nebraska and the Sugar Beet Industry.

To the Editor of the SCIENTIFIC AMERICAN:

As a constant reader of your instructive scientific journal, permit me to call attention to two communications which appeared lately, calculated, by inference at least, to do injustice to a part of this State, touching an industry in which we are all very much interested, viz., sugar beet.

Your issue of November 27 contained the following:

"Nebraska, also, is not likely to show rapid or immediate progress in the industry. Drouth and the lack of sufficient surface water to make irrigation practicable debar a considerable portion of the State from profitable agriculture, and, while eastern Nebraska has some very fine sections of land that in a normal year can be depended upon for crops that will compare favorably with Europe, the general results have not been good enough to warrant anything but most cautious progress. Two of the most desirable sites are now looking for a factory, and if such a one were built of not less than 500 tons capacity, it could, without doubt, be made to pay well. To sum up, therefore, the future of the industry in California and New Mexico is quite rosy; in Nebraska and Utah it is somewhat problematical, though by no means dark."

In a letter written by "Sarkander," which appeared in your issue of the 25th inst., he supplies statistics touching rainfall in the eastern part of this State. The writer says:

"The reports of the Weather Bureau are easily obtainable and ought to be made the basis of all such deliberations, for they are the only reliable source of information on subjects in regard to this new industry. A study of these reports bearing on the climatic conditions of the eastern half of Nebraska will convince every unbiased observer that these conditions are most favorable for the successful development of the beet sugar industry. Essential tests, quality and quantity, of beets grown in the State, in the existing sugar factories have proved this to be the case beyond any doubt or negation."

The reader is left to infer that the western half of Nebraska does not show as favorable conditions as the eastern half, or other parts of the United States. Had he examined records of the Chemical Department, State University, Lincoln, he would have discovered that, while the eastern half grows the larger tonnage of beets to the acre, the western half grows a beet richer in saccharine qualities. Also, that experiments generally teach that as they are extended toward the East, the tonnage gets greater and sugar qualities less, while toward the West, the "land of sunshine," which a beet must have, the tonnage grows lighter, but sugar qualities (saccharine and purity) greater. For instance: A recent bulletin issued by the State Experiment Station of Missouri advised farmers not to engage in the sugar beet growing, as results had been unsatisfactory, quality too low; while the following appears from South Dakota: "Out of four hundred tests of sugar beets made at the South Dakota Experiment Station at Brookings, many gave over twenty per cent sugar. Some farms give as high as twenty-four per cent. These are believed to be the most remarkable beet tests ever made."

So far as experiments in this State go, I understand that Sioux County, in the extreme northwest, has shown best results.

President Oxnard, of the two Nebraska and one California factories, has recently stated that results of this season's run in Nebraska are in every particular equally satisfactory with that in California, which ought to settle the question of any advantage that State has over us. Furthermore, certainly a difference of some two thousand miles nearer point of distribution and consumption ought to be in favor of this State.

Western Nebraska has land that can be obtained cheap, which has no superior for growing a rich beet; plenty of sunshine; limestone, building stone and the very purest water. Therefore, when capital begins in earnest to look up locations for factories, we hope we may not be overlooked on account of conclusions arrived at upon reading the two communications referred to.

C. H. CORNELL.

Valentine, Nebraska, December 31, 1897.

$100,000 for One-third of His Patent.

Millard F. Field, of Newport, has invented a machine for drawing in warps for looms, and has sold a third interest in his patent to B. P. Cheney, of Boston, for $100,000, says The New York Sun. It gages its work automatically, and it draws in 2,000 ends properly in seven minutes, something that would require the most expert workman about three hours to perform.

AN Englishman has just completed a journey of 1,600 miles on a motor car through England and Scotland. He was five weeks traveling and used 114 gallons of oil, which made his traveling cost him three farthings (a cent and a half) a mile.

Science Notes.

That birds build their nests by imitation has been called in question by Mr. A. G. Butler, of London, who says that the reason why many of them at the beginning of the season trifle with building material for some time before they produce a satisfactory result is that they are unable at once exactly to remember what the character of the nest was in which they first saw the light of day.

It has been noticed that in times of epidemics tanners are surprisingly free from attacks of the illness. This is due to disinfectant action of tannic acid. The cholera periods of 1850 and 1880, and later still the Hamburg epidemic in 1892, have clearly shown the comparative security of tanners. They are, however, attacked by two diseases peculiar to their trade, and caused by the manipulation of the skins. One particularly occurs frequently, attacking the finger tips and making the person afflicted unfit for the work. —La Science en Famille.

From the United States Monthly Weather Review for August we learn that the Postal Telegraph Cable Company is co-operating with the United States Time and Weather Service Company, of New York, in establishing throughout the city a number of handsome clocks which shall exhibit standard time, not only by the face of the clock, but by the dropping of a time ball at noon. Under the dial are panels which are filled up partly by special advertisements and partly by the latest Weather Bureau reports and forecasts, which are thus made known two or three hours before they appear in the afternoon papers. The stands contain, in addition, a barometer and thermometer. The clocks have also been erected in many Western cities, and the arrangement is somewhat similar to the so-called Urania columns, in Berlin, where they are said to be very popular.

After a long experience with typhoid patients, Dr. Ussery, of St. Louis, maintains that the best food for them is the banana. He explains by stating that in this disease the lining membrane of the small intestines becomes intensely inflamed and engorged, eventually beginning to slough away in spots, leaving well-defined ulcers, at which places the intestinal walls become dangerously thin. Now, a solid food, if taken into the stomach, is likely to produce perforation of the intestines, dire results naturally following; and this being the case, solid foods, or those containing a large amount of innutritious substances, are to be avoided as dangerous. But the banana, though it may be classed as a solid food, containing as it does some 95 per cent nutrition, does not possess sufficient waste to irritate the sore spots; nearly the whole amount taken into the stomach is absorbed, giving the patient more strength than can be obtained from other food.

A general professional indorsement is accorded views expressed by Prof. Allport, of the University of Minnesota, on some of the means at present required to protect the eyesight of children. He asserts that primarily in the structure of a school building as few obstacles to vision as may be should be permitted; ample illumination, whether natural or artificial, should be had from the left side of the desks; the desks themselves should be of such sizes as to permit the pupils' feet to rest firmly on the floor; they should also be provided with comfortable backs and slightly slanting tops, the latter placed at such distances from the eyes as to render sight easy without the close approximation of books; the blackboards, maps, etc., should be so situated as to be readily seen; an erect style of handwriting, less irksome to the eye than slanting characters, should be taught; and frequent changes of study or intervals of intermission should be secured, so as to avoid continuous work of one kind. Finally, school principals should be trained in the detection of eye disorders and in a system of notification to parents of discovered defects requiring attention from competent authority.

M. Raoul, a navy pharmacist of the first class, has just returned from a scientific mission to the far East. The object of his voyage, made on behalf of the French government, was to endeavor to find new plants likely to be of use in commerce and industry. The results of his mission are said to be of considerable importance, both from a commercial and scientific point of view. He penetrated into the interior of the island of Sumatra, and has written with some enthusiasm on the richness of the land. According to him, gold, petroleum, resin, India rubber, gutta percha, etc., are to be found there in plenty, but all cannot be utilized, because the natives are apathetic and will not work. He is said to have brought back rare plants, diverse in variety, which it is hoped to cultivate in the French colonies, and some are thought to be quite new. The task has not been an easy one, and toward the end he was taken seriously ill, and had to be carried for thirteen days through the forest and brushwood toward the coast. Some of his assistants and carriers were bitten by serpents, but they appear to have been satisfactorily treated by injections of Dr. Calmette's serum. That gentleman is director of the bacteriological institute of the island.

Miscellaneous Notes and Receipts.

Practical Production of Medicinal Soaps. — Thiosavonal is the name of new sulphur soaps soluble in water. For their production sulphurized oils are used (Ph. Centrh.) Grube gives the following directions for the preparation of thiosavonal. Soft sulphur soap: The thick liquid thio oil is made fluid with alcohol and gradually mixed, while being constantly stirred, with an equivalent volume of potash lye which is likewise thinned with alcohol. The addition of large quantities of potash lye at one time produces separation of sulphur, but this danger becomes less toward the end of the saponification. At last a small excess of potash lye is used. (The fact that all the thiosebacic acid has saponified is indicated by the liquid appearing clear as a whole and a sample taken being clearly soluble in water as well as in alcohol.) The excess of alkali is neutralized by volatile fatty acid. The soap solution thus obtained is freed from the alcohol in a steam bath and boiled down to the consistency of soft salve, being occasionally tested for neutrality. 85 parts of this soap are mixed with 15 parts glycerine. The percentage of water in this mixture is 12, that of thiosebate of potassium is 5.

Liquid Sulphur Soap.—The mode of production is the same as above described, but the soap solution is only boiled down to the consistency of sirup; 88 parts of this liquid soap are mixed with 12 parts glycerine; There is 29·6 per cent water in this mixture and 4 per cent thiosebate of potassium. Both thiosavonals may be readily mixed with larger quantities of tar, the salvelike thiosavonal at a moderate heat.

The mixing and determination of a new shade of color, in all branches of industry, such as cloth and carpet factories, cotton print works, dye houses, colored paper and wall paper factories, picture-printing establishments, paint shops, etc., as weli as in art, says the Färben Zeitung, is a very tedious and laborious process the way it is now performed. The testing and mixing of a new tint may be accomplished in a simple and quick manner by the dry process, using gelatine or glass plates for this purpose, which are dyed in all primary colors and some mixed colors, with all the gradations from light to dark of each color. If two or more of these colored plates are put together and held against the light, the effect of the mixture can be seen immediately. Suitably arranged in a receptacle, these colored plates are the simplest and most convenient means of producing any desired color mixture and testing the effect at once. This may be regarded as a crude method, compared with the rotating disks already described in the SCIENTIFIC AMERICAN.

Gutta Percha Paper.—According to a patented process, says the Rundschau, a fabric saturated with glue or gelatine solution and subsequently treated with gaseous or dissolved formaldehyde furnishes a good substitute for gutta percha paper. The formaldehyde renders the glue or gelatine insoluble in hot water and prevents cracking.

For Drilling Glass.—An optician recommends the following method: Dip a drill borer heated to white heat first into quicksilver, whereby it is excellently hardened, and sharpen by grinding on a whetstone. If the drill thus prepared is moistened with a saturated solution of camphor and oil of turpentine and the borehole is kept rather moist, glass may be drilled like wood.

Lubricant for Plaster Moulds.—The mixtures, greases and oils usually employed for this purpose have the disadvantage of being sticky or of easily attracting dust. According to Puscher, this drawback is avoided if stearic acid is used instead. Melt one part stearic acid in a glass by immersing the same in boiling water and add four to five parts alcohol (95 per cent). Agitate the clear solution until cold, whereby a thin paste of very finely distributed stearic acid is formed, with which the moulds are coated by means of a painting brush. The spirit evaporates at once and leaves a very thin layer of stearic acid, which admits of readily freeing the cast from the mould.

Leaks in steam pipes may be stopped with manganese cement, which hardens in a few hours. The composition of the cement is as follows: 4 parts black manganic oxide, 10 parts litharge, 5 parts red lead, 5 parts unburnt limestone and 5 parts yellow ocher. Pulverize, mix well and knead into dough, adding a little boiled linseed oil and asbestos fibers.

Black Leather Varnish.—Into a spacious glass flask pour 4 liters of spirit, to this add, somewhat reduced, 150 grammes of the finest shellac, 50 grammes of sandarac and 20 grammes of mastic and dissolve completely, shaking frequently. To this still brittle varnish add 100 grammes of pure Venetian turpentine. When the whole has dissolved uniformly clear, it is dyed deep black with nigrosine (aniline black) soluble in spirit or in water. For this purpose lampblack is also recommended. The varnish should always be kept well closed up, and if it should thicken in time, owing to the spirit evaporating, it can be diluted again with spirit. The process can, of course, be carried out on a larger scale.—Färben Zeitung, November 10, 1897.

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THE GREAT TRAINING JETTY AT THE MOUTH OF THE COLUMBIA RIVER, OREGON.

(Continued from first page.)

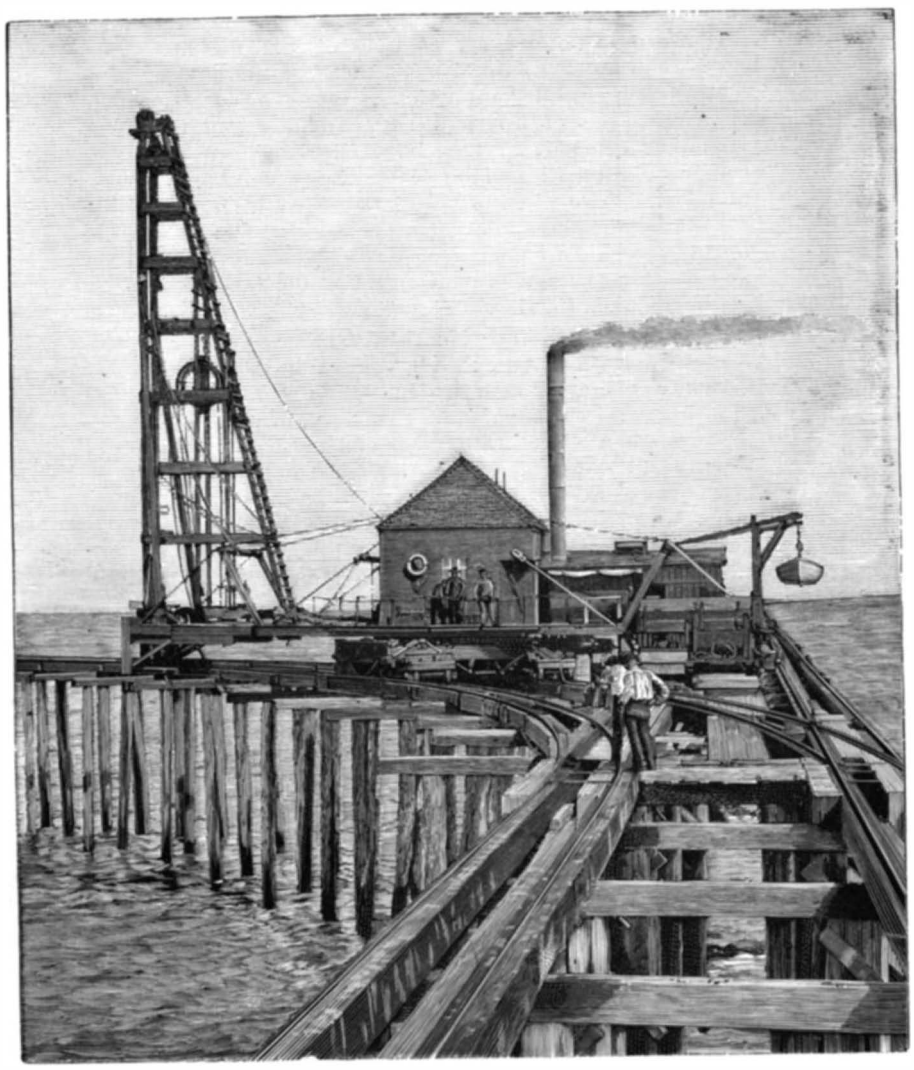
the largest ships afloat at any state of the tide or weather.

In constructing the jetty a double track pile trestle was built to carry out the mattresses and rock filling, the trestle being kept a short distance ahead of the rock. The bents were 16 feet apart and each bent consisted of four piles, the outer piles being 18 feet from center to center. The bents were capped with timber 12 inches by 12 inches and 22 feet long. The two tracks, 13 feet center to center, were laid directly on four lines of 12 inch by 16 inch stringers. The pair of piles beneath each track were braced with 6 inch by 6 inch braces, 10 feet long.

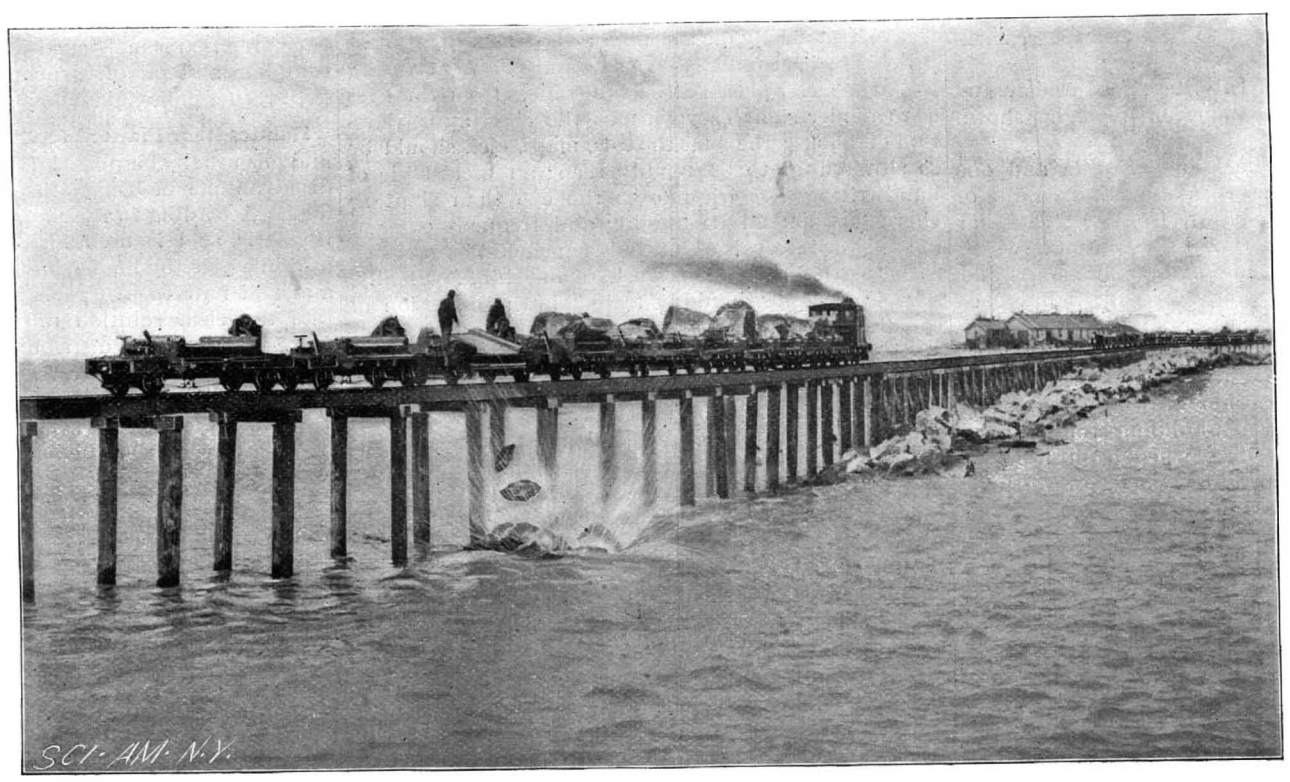
A large and powerful hydraulic or jet pile-driver was specially constructed for the work. It was carried upon four eight-wheeled trucks and revolved upon a turntable whose platform was formed of heavily trussed timbers. This platform was 17 feet long by 19 feet wide and covered both tracks, its load being transferred to the trucks by box girder transoms. A circular track of 30 pound rail was laid upon the platform and a similar track was bolted beneath the floor of the pile-driver. The latter was 64 feet long, and was so arranged that the gins, hammer, etc., at one end balanced the boiler, tank, fuel, etc., at the other end. A stout pyramidal gallows-frame was built above the track circle, from which a set of heavy hog chains led down to the ends of pile-driver floor or frame, thus relieving it of bending strains and allowing it to be kept up to level. The engine, which was placed over the track circle, turned the driver, propelled it on the rails, and hoisted and drove the piles. A pump for working the hydraulic jet was located on a platform attached to the side of the driver. From the pump the water was led by a 4½-inch hose to a V-shaped coupling, from which it was conducted by two 2½-inch branches to a couple of pipes which were loosely attached on each side of the pile by means of staples, the bottom of the pipes terminating near the foot of the pile.

When a pile was to be driven, the pile-driver was swung around, and a hoisting rope, which passed over the sheave at the top of the gins, was made fast to the large end of one of the piles on the tender. The two jet pipes were then fastened loosely down each side of the pile, and the pile was hoisted, swung round and lowered into position. The pump was then set to work, and the weight of the pile and the hammer—the latter being lowered onto the head of the pile—caused it to settle as the jets of water loosened the sand. The average rate of sinking was 10 feet per minute. When the water jet had sunk it nearly to grade, a few taps of the hammer completed the work. As soon as the pipes and hose had been disconnected, the sand closed tightly about the pile, giving it the necessary frictional resistance and bearing power. It was not necessary to build any temporary platform for cutting off the piles. This was done when they lay on the gridiron before the driving, a mark on the hammer serving to indicate during the sinking when the proper level had been reached. The driver was then swung round again to the tender, and a cap was picked up, brought round to the front, laid in place and drift-bolted, similar operations being gone through in laying the stringers and rails.

After a certain length of trestle had been completed, the brush mattresses or fascines were built and sunk to the bottom. The object of the mattresses was to form a foundation for the rock, hold it together and prevent it from sinking piecemeal into the sand. They were laid in two long strips, each 20 feet wide, one beneath the trestle and one adjoining the trestle on the north side. The inside mattresses were lowered from the floor of the trestle and sunk by piling rock upon them. They were 20 feet wide, 64 feet (the length of four bents) long and 5 feet thick. Those on the outside were 20 feet by 20 feet in area and 3 feet in thickness. They were all built of brush and poles, with five or seven stops alternating in direction on the layers of brush and securely fastened by wire or rope to the poles. The placing of the outside line of mattresses in position necessitated the construction of special launching cars. These consisted of flat cars on which frames or platforms measuring 20 by 24 feet were carried upon rollers. The mattresses were brought to the site on these cars and, by means of a tripping gear and tripping lines, the platform was given a sufficient pitch to slide the mattresses off into the water.



THE JET PILE-DRIVER USED IN CONSTRUCTING THE TRESTLE.



DUMPING ROCK AFTER MATTRESSES HAVE BEEN LAID IN PLACE.

The rock for the jetty was quarried on the banks of the Columbia River and towed in barges to the docks at the shore end of the structure. Here it was hoisted by steam derricks onto self-righting dump cars, of the pattern shown in the front page engraving, which carried from five to eight tons each. These were made up in trains of ten or a dozen cars and hauled out to the end of the jetty, where the rock was dumped onto the newly laid mattresses. The dumping was done by means of a rack and pinion, and was so expeditious that two men could dump twenty cars of rock in five minutes. When the jetty was nearing completion, three spurs were run out for the purpose of protecting the shore line. The first two were washed out by heavy surf, but the third attempt was more successful, and a substantial breakwater now extends from a point near the commencement of the jetty proper across the dock in a southeasterly direction a distance of about half a mile.

In a work of this magnitude the total quantities of material reach remarkable figures. In the present case the material in the jetty and its groins includes over half a million lineal feet of piling, nearly four million feet of sawed lumber and about one million tons of rock.

The construction of this important work has served to call public attention to the rapidly growing commerce of the Northwest, and the part which the Columbia River with its tributaries is destined to play in developing the States of Oregon, Washington, Montana and Idaho. This wonderful river drains a territory fully four times as large as all the New England States combined. For a distance of 560 miles from its mouth there is but one serious obstacle to navigation, the Cascade Rapids, and this may now be passed by way of the splendid lock recently completed by the government engineers. There is every reason to believe that the dream of John Jacob Astor, the founder of Astoria, at the mouth of the river, will ultimately be realized, and that its growth will rapidly entitle it to a leading position among the centers of commerce on the Pacific coast. Our thanks are due to Mr. M. J. Kinney and Mr. Robert Gibson, of Astoria, Oregon, for the illustrations and data used in preparation of the present article.

A Cheap Ruby Lamp.

An inexpensive dark room lamp may be easily made from an empty tin (a one pound French coffee tin does admirably). One inch from the top, and parallel with it, by means of a small file, cut a slit 3 inches in length, and quite underneath it cut another one parallel with the bottom of the tin, 1 inch from it, and the same length as that above it (3 inches). Now, from the ends of the slits already made cut two slits (which, if properly done, will be parallel to each other), so as to take a square quite out of the side of the tin. A double piece of ruby fabric is now to be glued over this square hole. Now in the center of the bottom a circular hole of ¾ inch in diameter is to be cut (by means of a flat file or an old knife). A piece of tin, ½ inch less in width than the diameter of the tin, is to be bent in the shape of a V, with a piece protruding on each side. This is now to be soldered inverted to the bottom of the tin, over the hole, so as to prevent any light escaping from the hole, which is for the purpose of ventilation. A tin tack is now to be driven through the lid of the tin (point inward) and its head soldered to the lid of the tin. By pressing a night light or small piece of candle on the point of the tack, and placing the tin in its lid, we have an inexpensive ruby lamp. When required for use with isochromatic plates, fasten a piece of yellow fabric over the ruby by means of elastic bands at top and bottom. The brighter the tin is inside, the better, for the sides then act as a reflector.—Photographic News.

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HIGH ELECTROMOTIVE FORCE.

PROF. JOHN TROWBRIDGE.

I have lately perfected a large plant for the study of the discharges of electricity through gases which I believe is more extended, and on a larger scale, than any at present in existence ; and I have obtained some results with it, especially in the subject of high electromotive force, which throw light upon many mooted points. The source of electricity which produces the electrical discharges is obtained from ten thousand storage cells. From these cells I obtain very approximately twenty thousand volts, and by means of a peculiar apparatus called Planté's rheostatic machine, I am enabled to obtain over one million volts—which enables me to experiment with powerful discharges in air, more than four feet in length.

By the employment of storage cells in the subject of the discharges of electricity through gases, one can form a fair estimate of the amount of energy that is employed to produce the desired effects—for instance, the X rays ; while with the use of electrical machines or induction coils and transformers it is extremely difficult, if not impossible, to form an accurate estimate. Fig. 1 is an illustration of the type of cells of which the battery consists. Each cell is composed of a test tube 5½ inches long and ¾ of an inch internal diameter containing two strips of lead which are separated from each other by rubber bands and are immersed in dilute sulphuric acid. The surfaces of the lead strips are roughened by a mechanical device, and the cells are charged in multiple circuit by means of a dynamo machine. When the cells are properly formed, each one gives two volts and has an internal resistance of one-quarter of an ohm. The problem of insulating these cells was a serious one ; but it was practically solved by mounting the cells in sets of threes, in holes bored in a block of wood which had been carefully boiled in paraffine. The mechanician of the laboratory, Mr. George Thompson, devised a simple switch board which enables me to throw the cells into multiple or into series—to use the entire ten thousand, or suitable portions of this number. The battery gives eight amperes of current with twenty thousand volts, and this amount of energy is amply sufficient to kill a man. By accident an operator received the shock from only one thousand of the cells and was badly shocked and burned. It is prudent therefore in experimenting with this battery to use rubber gloves, even in throwing the switches, and it is recommended to employ only one hand covered with a rubber glove and to keep the other hand in a pocket.

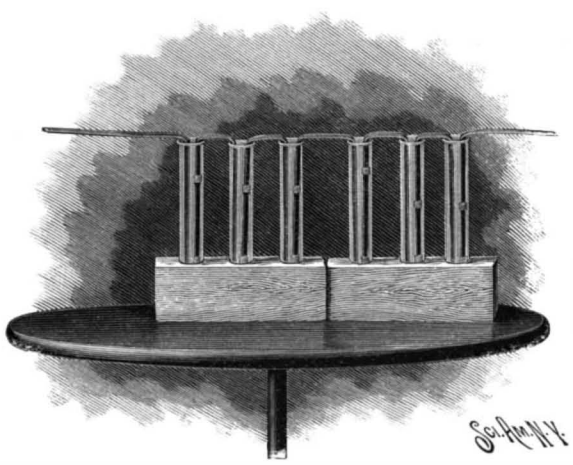

Fig. 1.—THE CELLS.

I had at first intended to use this large battery in the study of electrical discharges through Crookes tubes, but I speedily found that X rays could not be excited by a difference of potential represented by twenty thousand volts. I found that at least one hundred thousand volts were necessary to produce them strongly, and I, therefore, resolved to construct a Planté rheostatic machine. This machine is simply an apparatus by means of which Leyden jars are first charged in parallel and are then discharged in series or by cascade. That is, all the inside coatings of the jars are connected to the negative terminal of the ten thousand cells, and all the outside coatings are connected to the positive terminal of the cells. When the cells are charged, the inside of one Leyden jar is connected to the outside of the next, and so on. In this way a very high electromotive force can be obtained. I use sixty Leyden jars in the form of plates of glass 15 × 18 inches coated on both sides with tinfoil. Starting with twenty thousand volts, I can exalt this to one million two hundred thousand volts. The accompanying illustration (Fig. 2) shows the Planté machine. The mechanician of the laboratory has introduced a notable improvement in the apparatus of Planté. Instead of a revolving commutator such as was used by the latter, Mr. Thompson employed lever arms, by means of which the jars were first charged in parallel and then discharged in series. It was found that the apparatus designed by Planté could not be used for higher voltages than one or two thousand without serious error and loss. By means of this apparatus I can study electrical discharges at least four feet in length--of great body—which are produced by an electromotive force of one million two hundred thousand volts. This apparatus possesses the great advantage that it enables one to obtain a fairly exact measure of such high voltage. When we reflect that the trolley car employs only five hundred volts, and in the system of transmission of power from Niagara Falls it is proposed to use only ten thousand volts, it is evident that the effects produced by voltages of over a million must be of great scientific interest.

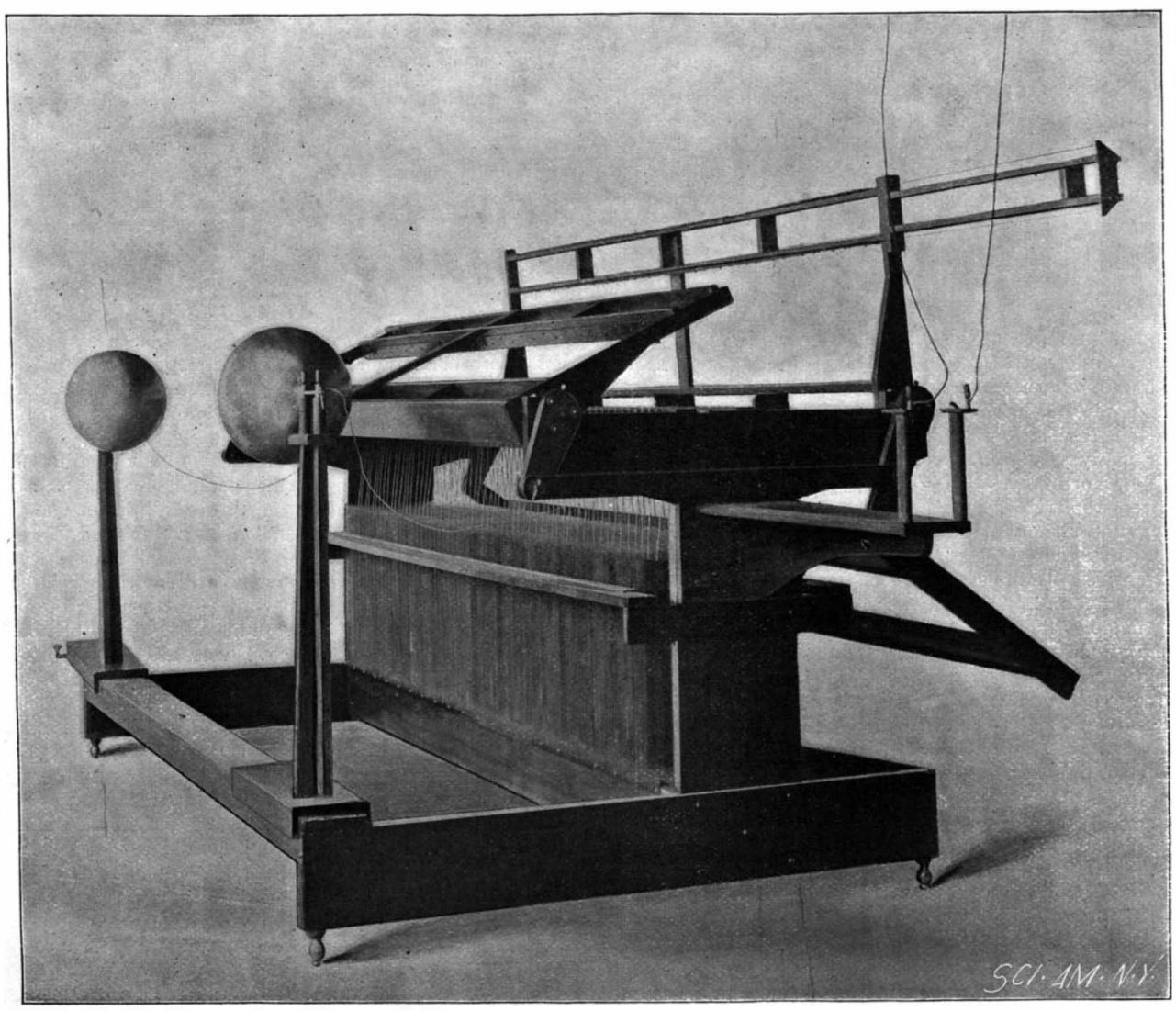

Fig. 2.—PLANTÉ RHEOSTATIC MACHINE.

The study of such high electromotive forces immediately showed that previous estimates of the electromotive force necessary to produce a spark of a certain length were highly erroneous. For instance, Heydeweiler, a German investigator, believes that Prof. Elihu Thomson's statement, that a spark of five feet in length which he produced required a voltage of five hundred thousand, is very wide of the mark, and Heydeweiler maintains that one hundred thousand would be nearer the truth. I find that even Prof. Thomson's estimate must be more than doubled. Experiments with my apparatus show conclusively that the length of the electric spark between points separated by more than one inch varies directly with the electromotive force. A spark forty-eight to fifty inches in length requires an electromotive force of one million two hundred thousand volts, and a discharge of lightning one mile long would therefore require the enormous number of over one hundred million volts. In reflecting upon the development of such enormous energy in the air we can understand why telephone bells ring during a thunder storm ; why subsidiary sparks occur in networks of wires ; and why telegraphic messages are interrupted. The world beneath the thunderstorm throbs and pulsates with the oscillatory discharges of lightning.

One of the most interesting results of my study of powerful disruptive discharges is the discovery that such discharges will pass through glass tubes which are exhausted to such a high degree that they are said to contain a vacuum ; for the eight-inch spark of a Ruhmkorff coil prefers to jump around the tube to passing through the extremely rarefied space in the interior of the tube. Such tubes, however, are brilliantly lighted by a difference of potential of a million volts and readily show the X rays, and exhibit the skeleton of the hand in a fluoroscope. The so-called brush discharge from the positive terminal of the Planté machine extends visibly to a distance of over a foot. If the hand is exposed to this brush, it produces the well known X ray burn, such as various investigators have received in taking photographs of the skeletons of their hands, or in testing the condition of Crookes tubes by exposing their hands before a fluoroscope. The skin of the hand becomes irritable and turns a bright red color, especially after exposure to cold winds.

This result interested me greatly; for it proved that the so-called X ray burn could be produced by the brush discharge of very high electromotive force. The extent of the influence of this powerful brush discharge is very great. For instance, photographic plates in a plate holder carefully insulated from the ground and covered with a plate of glass half an inch in thickness show the inductive action of the brush discharge from the positive terminal, which is distant at least a foot. These inductive effects are manifested by star-shaped figures on a photographic plate. They are surrounded by dark clouds. When the burn on the back of one's hand produced by such brush discharges is examined by a microscope, similar centers of disturbance (in this case points of inflammation) are seen. Although the Leyden jars of my machine are carefully insulated on supports of vulcanite which are mounted on dry wood, which in turn is supported on rubber, I can obtain a discharge of more than two feet in length when I bring a point connected to the steam pipes to the neighborhood of one terminal of the machine. The other terminal of the machine is carefully insulated. This experiment shows conclusively that it is of no use to insulate lightning rods. My experiments thus far show that no vacuum which I can produce can resist the discharges which are caused by one million volts. It now becomes an interesting question whether there exists mechanical or chemical means by which a so-called vacuum can be produced which will resist such discharges.

ACCORDING to The London Electrician, a curious accident recently happened to a gas engine in the works of Messrs. Nalder Brothers & Thompson, London. Owing to a flaw in the shaft, it suddenly snapped off short outside the bearing. The flywheel, weighing 780 pounds, and the pulley were thus dropped on the floor while running at a rate of 300 revolutions per minute. Fortunately the belt remained on the pulley, and pulled up the flywheel without any serious damage resulting. A motor company was immediately telephoned, and forwarded at once an alternating current motor, by the aid of which the shops were running again the same evening.

THE art of making stockings in a frame was invented by the Rev. Mr. Lee in 1589.

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Manufacture of Wax Cloth, Leather Cloth, etc.

The name wax cloth carries us back to those ancient days, several decades removed, when it was really attempted to waterproof materials by means of bees' wax or waxlike substances. At present everybody uses oils or varnishes, also rubber; the latter goods would be distinguished by name. The texture, says The Gummi-Zeitung, may be coarse or fine, but it should be homogeneous. Linseed oil, admixed or not with resins and other oils, is the chief ingredient which is generally applied to the stretched texture. When this is done by hand and brush, an almost obsolete process, of course, the first cloth is stretched near the floor and the others are fixed in succession above it, as the work proceeds. For large pieces the hand brush does not answer. Machines do their work more uniformly. The first coat requires the greatest care; the second coat may be applied as soon as the first varnish is no longer sticky or after thoroughly drying and rubbing the first skin, in order to remove all knots and blisters, etc. No color is admixed to the oil furnishing the first skin. A good wax cloth generally gets three layers and a further facing with a transparent varnish, mostly copal, diluted with oil of turpentine or petroleum. The layers of coloring matters should always be very thin. Wax cloth works are not desirable neighbors; the drying processes are apt to be malodorous. The first coat applied to canvas for packing should also be linseed oil, without any dye, lest the stuff should crack. The black color is produced by means of soot; the texture must be loose. The leather cloth, which came over from America about 1860, has a base of very firm and smooth cotton texture. This is stretched over rolls; the first coat consists of a solution of rubber in petroleum. Before this has completely dried, very finely powdered materials, French chalk, magnesia, ocher, zinc oxide, English red, ultramarine, soot, etc., are spread on the cloth; the sieves are pieces of silk gauze kept in reciprocating motion. The excess of powder is removed by means of soft brushes, and one or more coats of varnish are then applied; the outer skin should always be a transparent varnish. The tar which is to render sail cloth waterproof must be boiled for some time in closed retorts in order to get rid of the more liquid constituents; the distillation products of this operation are, of course, collected. Heavy cloth is tarred on both sides, and is not, as a rule, elastic. The admixtures to tar, certain soaps, rubber, tar oils, etc., do not supply any cheaper articles.

PUEBLO ARTS AND INDUSTRIES.

BY COSMOS MINDELEFF.

In a recent annual report of the Bureau of American Ethnology there appears a full and complete translation of an old Spanish document which is of the greatest importance, not only to the better understanding of the events which led up to and followed the Spanish discovery and conquest of the region we now term New Mexico and Arizona, but also to the student of Pueblo art and culture. The document referred to is Castañeda's narrative of the Coronado expedition, made in 1540, and has a curious history. Its importance is indicated by the fact that, of the hundreds of books and special articles which have been written about the Southwest, probably not one was finished without more or less extended reference to Castañeda. Yet, up to this time no complete translation into English had been printed, and, what is more strange, the fragments we have had were all, with one exception, taken from a French translation, while the Spanish text has been for many years in the custody of the Lenox Library, in New York City.

The narrative was written about 1560, some twenty years after the expedition, but, although search has been made for the original in Simancas, Madrid and Seville, where there are extensive collections of Spanish documents, it has not yet been found. The copy now in the Lenox Library was made at Seville in 1596, and is the one used by Ternaux-Compans in preparing a translation into French, published in 1838, in his "Collection of Voyages." This French translation has now been shown to be very defective, for the Spanish was sometimes rendered with great freedom, and in several cases the translator failed to understand what the original writer endeavored to relate. Notwithstanding these radical defects, the French translation has been the source of practically all the knowledge of Castañeda's account that we have, and the publication of a complete English translation from the Spanish text will be of great value, especially as the publication is accompanied by the Spanish text itself, and by numerous related documents, in the original Spanish, with English translations, consisting of other descriptions of the same expedition. The translation was made by George Parker Winship, of Harvard University, than whom no one could be more competent, and he is also the author of the article referred to which is printed under the title "The Coronado Expedition, 1540–1542," in the annual report of the bureau referred to.

The value of Castañeda's narrative is largely in the graphic and, on the whole, consistent account he gives of the Pueblo Indians of 1540, their houses, manners and customs, arts and industries. The general truthfulness of the account is apparent, aside from all other proofs, from the fact that, although more than three and one-half centuries have elapsed since the Coronado expedition boldly plunged into the unknown country north of the Gila River, and eventually reached the Pueblo country, Castañeda's descriptions of the manners and customs of the Indians might almost have been written by a careful observer who traveled through the country fifteen or twenty years ago, before the advent of the railroads.

For over thirty years following the Pacific Railroad surveys in 1853–54, which practically first brought the Pueblos under our notice, there were tremendous controversies as to the location of the "seven cities of Cibola," the search for which was the prime cause of the Coronado expedition. It is now universally admitted that the Province of Cibola of 1540 and the Zuñi country of to-day are the same, and this complete identification adds much to the value of Castañeda's narrative. At the time he wrote the Zuñis lived in seven villages located in the valley of the Zuñi River, within a short distance of each other. One of these, called Haloua, has been partly covered by the modern village of Zuñi, built over its remains, while the others are located by well marked ruins in the vicinity.

The houses are described by Castañeda as being ordinarily three or four stories high, but consisting sometimes of seven stories, all with flat roofs. They did not have doors below, but the people used ladders, which could be lifted up like a drawbridge, and so the men could go up to the corridors (or terraces) which were on the inside of the village. The doors opened on these terraces, which served as streets. A reference to the illustration, showing some terraced houses in modern Zuñi, will demonstrate the essential accuracy of this description. The overhanging roofs shown here are mentioned also in the old narrative, and almost the only modern innovations to be seen are the dome shaped structure in the foreground, which is a baking oven patterned after those of the Mexicans, and the chimneys. The latter, although not of aboriginal origin, are one of the most picturesque features of the Pueblo villages.

Externally the chimneys consist of one or more old water jars of pottery, with the bottoms knocked out. The pots are placed one above another, sometimes in a series of seven or eight, and usually rest on a plinth or base of masonry or of adobe. In the interior there is often an elaborate smoke hood, formed of small sticks covered with clay, like that shown on the right of the picture illustrating Hopi grinding and bread making. Sometimes the hood is formed of slabs of stone, cleverly fitted and keyed together. Under the hood there is a fireplace of stone, and the whole structure is commonly placed in a corner of a room, the walls of which furnish two sides of it.

The illustration of terraced houses in Zuñi shows also some of the roof trap doors which are described in the ancient narrative as being "like the hatchway of a ship," for that peculiar construction has come down to the present day unchanged by the lapse of centuries. In the olden days, and to a large extent now, access to the first story rooms could be had only through these trap doors, as no large openings were made in the first story wall. Ladders are used from the ground to the first roof or terrace, and from this other ladders descended into the rooms.

When the Spanish soldiers led by Coronado stormed the first of the "seven cities of Cibola" they were feeble and worn out by long journeying and lack of food, but after an hour of stubborn fighting they conquered and took possession of the houses, where they found an abundance of food; for the Zuñis of old, like their modern descendants, were a provident people and laid by great stores of food. It is no uncommon thing to-day to find supplies sufficient for three or four years carefully put away in the inner rooms of the terraced houses. This trait, which is entirely at variance with the improvidence which characterizes nearly all the other Indian tribes, is one of the peculiarities of the Pueblos; and until law and order were established by the American conquest of the country in 1846, it made these people the target of numerous attacks by the surrounding wild tribes—the Utes, Navahos, Comanches and Apaches—who found in the Pueblo homes convenient and never failing storehouses, from which they could draw supplies of food.

The Pueblo Indians have always been successful farmers, and even under the unfavorable conditions which prevail in the sub-arid region where their homes are located, they seldom fail to secure good crops. In the dry, clear atmosphere for which New Mexico and Arizona are noted, food is easily preserved, and almost everything is dried for future use. Meat of all kinds is merely cut into long strips and hung in the open air for a few days, after which it will keep indefinitely. In the late summer and autumn months the somewhat somber yellowish gray tone of the houses is enlivened by strings of red peppers hung on the walls or festooned from the tops of the ladders; split squashes line the tops of the raised copings, while hundreds of square feet of the roofs are covered with peaches, split and whole, or with bushels and bushels of corn, dark blue, white, and parti-colored.

In fact, corn has always been the staple, the main reliance of these people. Among the Moki towns in northern Arizona, where the conditions are very unfavorable, large crops are raised without irrigation, although the average white farmer would be hard pushed to harvest the amount of seed he put into the ground. The methods followed are peculiar and distinctively Indian. The seed is always planted in what appears to be pure sand, generally in the bed of some intermittent stream or drainage channel, where deep down in the ground there is always a little moisture. The seed is planted at a great depth, often two feet or more; holes are made with a planting stick and a small handful of grain is dropped into each. The plants come up in thick clumps, instead of in rows, and are not thinned out; for when the summer rains come the water flows in its natural channels, and only heavy clumps could withstand its force.

The native corn or maize has practically disappeared within the past ten years. This is much to be regretted, for in sweetness and delicacy of flavor it was much superior to many of our so-called sugar corns. Perhaps in some remote districts away from the traveled routes it may still be found, but elsewhere the partial settlement of the country by whites and the constant passage of wagons has destroyed it. Where wagons go, there American corn is carried to feed the horses, and the Indians, tempted by the larger grain of our corn, have picked up the waste and planted it in their fields. The well known facility with which corn cross-fertilizes has done the rest, and the native species are now almost extinct.

However, corn is to-day, as it has always been, the distinctive Indian grain, and they have many ways of preparing it for food, but the bulk of the crop is dried, and, as occasion demands, is made up into bread. The illustration, which is from a photograph of a model in the National Museum in Washington, shows a group of Moki (or as they call themselves, Hopi) women and girls preparing piki or paper bread. In one room in each house there is a binlike trough along one side, placed directly on the floor and framed in with low slabs of stone set on edge. This bin is divided by transverse pieces of stone into three or four compartments, and in each of these there is mounted on a slight incline a flat piece of rough stone, usually black lava, which is abundant in that country. This is the metatl of the Aztecs, the mitata of the Mokis, and in connection with a small piece of flat stone which is rubbed back and forth over the lava slab, is the grinding mill of these people.

The corn, having been previously soaked in water to loosen the hard outer skin, is thrown into the first compartment, where it is rubbed between the stones into a coarse meal. This is passed over into the next compartment, where it is ground finer, and then into the next, where it emerges in a fine meal, as fine as our wheaten flour. Castañeda, in his account of Cibola, says that a special room is set apart for the grinding of the corn, and that this room contains a furnace and three stones made fast in masonry. Three women sit down before these stones; the first crushes the grain, the the second brays it, and the third reduces it entirely to powder. The accuracy of this description is apparent.

The fine powder which comes from the third grinding is mixed with water to a thin batter, which another woman spreads with her hand on a heated stone, and immediately after peels off a thin layer about the thickness of heavy manila paper. A number of sheets of this peculiar bread are shown piled up in the center of the picture in front of the mealing bin. Ordinarily it is of a dark blue color, as it is made from blue corn, but for ceremonial feasting it is made of pink, or yellow, or white, or variegated corn, and in each case partakes of the color of the grain. When fresh, this bread is quite palatable, but when a day old it becomes very brittle; and, as it is usually made without salt, it tastes much like sawdust.

The flat stones on which the paper bread is baked, one of which is shown on the extreme right of the picture, are considered very valuable and often descend from mother to daughter through many generations. Their manufacture is a secret process, carried on only by certain old women of the tribe at a distance from the villages and accompanied by numerous rites and ceremonies. A certain kind of stone must be selected in the first place, and it must be of even grain and free from cracks or flaws. Then, after being rubbed smooth, it is treated with pitch and perhaps other ingredients, with frequent exposures to fire and smoke, and at intervals certain incantations and formulas must be repeated. At one stage in the preparation the strictest silence must be observed, as, it is said, a single word spoken then will crack the tablet. If all goes well, the final product is a stone of jet black color, instead of the light yellowish gray of the original sandstone slab, with a highly polished surface, from which the flakes of paper bread peel off readily. If, however, there was any flaw in the stone, or if some of the formulas or incantations were omitted or wrongly pronounced or spoken in the wrong order, the stone

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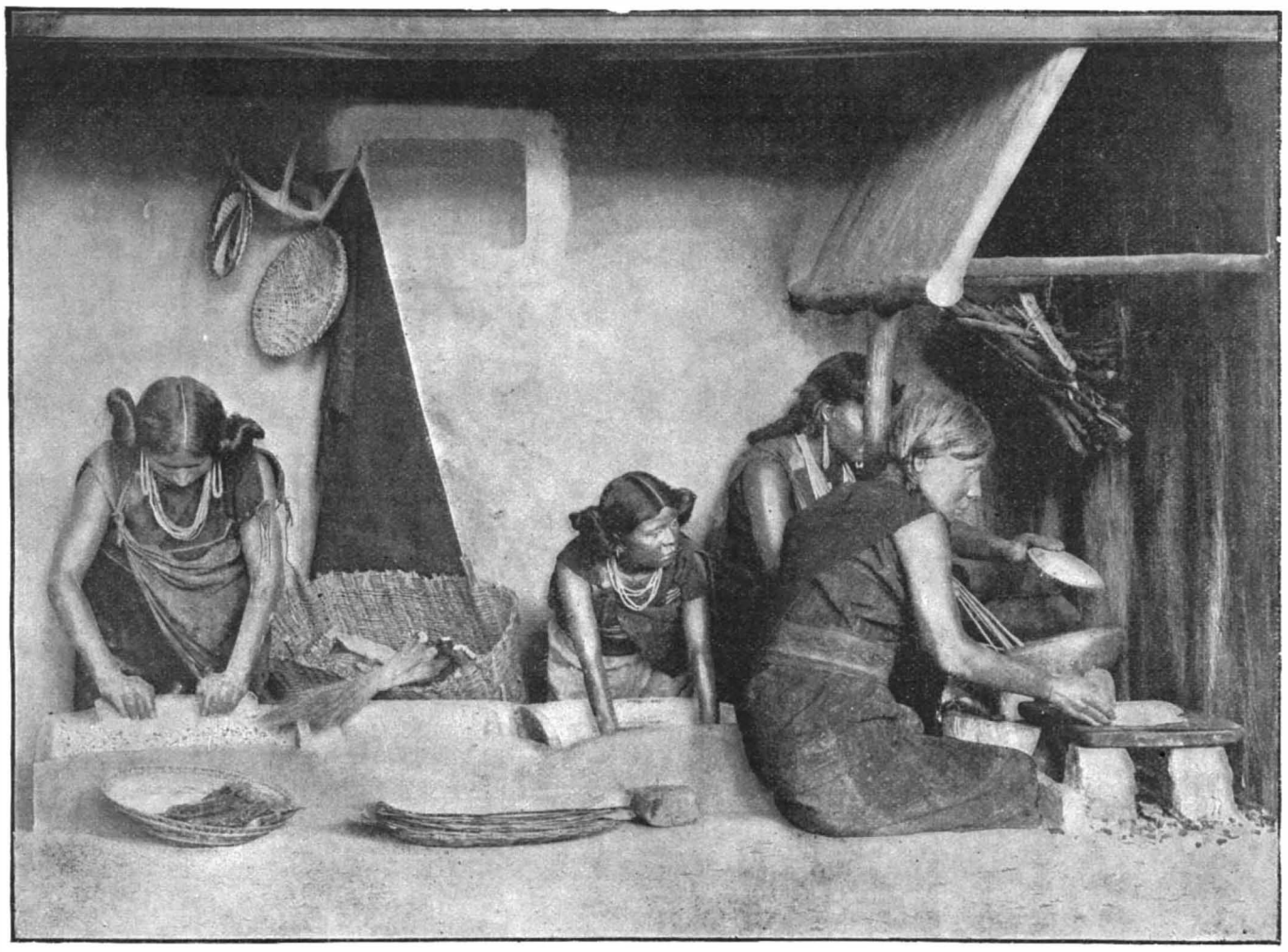
will crack when exposed to the fire and will be worthless. It will be noticed that the stone is mounted some six inches above the floor on low pillars, built up of bits of stone and adobe mud. Commonly it rests on two slabs of stone on edge, forming a boxlike flue or stove, in which a hot fire is maintained by constantly feeding in small sticks.

When there are young girls in the family the grinding of the corn is their especial duty, and is always done by them alone. The work is partly ceremonial in nature and is done in a certain way, being generally accompanied by a weird song, sometimes called a love song, to which the grinders keep time. When three maidens take their places behind the bin to grind, it is not unusual for some young man who is interested in one of them to act as musician. Squatting near by, he evolves a peculiar purring sound by rubbing a stick over another one in which small notches have been cut, while the maidens themselves sing to this accompaniment. The rubbing is always done by a motion of the body from the hips, the arms being held rigid. At intervals the grinding stone is moved with one hand alone, while with the other the corn or coarse meal is gathered up from the bottom and sides of the bin and placed above it. As the small stone is worked with a slight rocking motion the grain slowly passes under it, and this is repeated until the required degree of fineness is attained. The description of this simple but effective mill by Castañeda in 1540 shows that it was the same then as it is now and that it is of distinctly aboriginal origin.

The peculiar style of hair dressing is shown by the two figures at the left of the picture. The hair is so worn only by the maidens of the tribe, and by them only from puberty until marriage. The custom appears to be of great antiquity, for it was noticed by Castañeda in 1540. The hair is arranged in disklike projections on either side of the head, as shown in the illustration. These disks have a symbolical meaning and are thought to represent the squash flower, itself the symbol of fertility among these people. After marriage the women always wear their hair in two short queues wound and tied with a ribbonlike strip of their own weaving.



HOPI GRINDING AND PAPER BREAD MAKING.

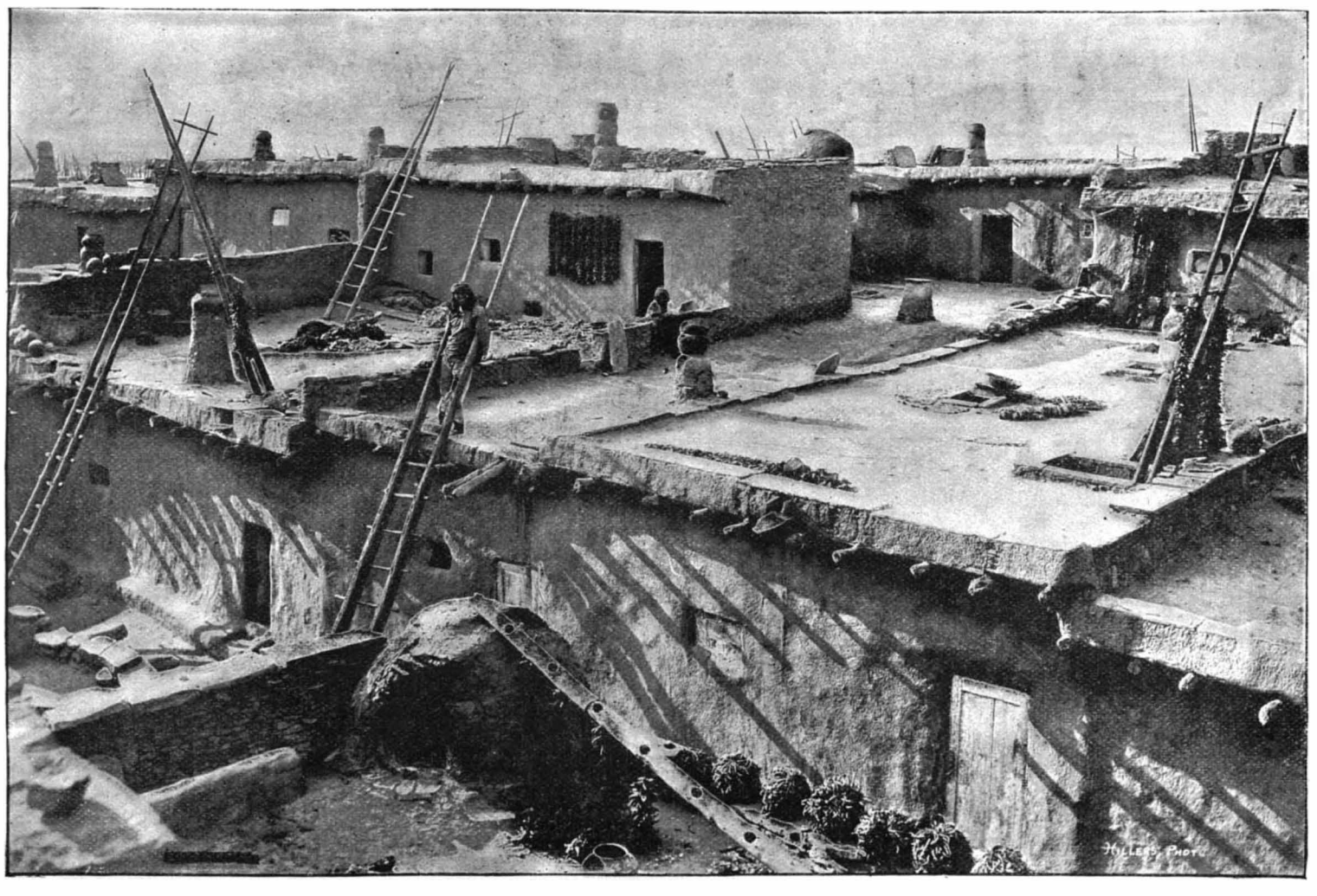
A Telephone for the Submarine Boat.

A telephone has been added to the equipment of the "Argonaut," the submarine boat shown in our last week's issue. This vessel can be connected telephonically by calling up "3041 Baltimore." The tests have been very successful and there was no difficulty in communicating with Washington. The wire is stored on a reel and is inclosed in a watertight tube.

The Current Number of the Supplement.

The SCIENTIFIC AMERICAN SUPPLEMENT for the current week, No. 1150, contains four or five articles of more than usual interest. "The American Bicycle: Its Theory and Practice of Construction," by Mr. Leonard Waldo, deals with the scientific aspect of the bicycle, not as an assemblage of parts, but as a concrete machine of remarkable efficiency.

The article is accompanied by tables giving valuable data based on experiments with modern testing apparatus, touching especially the comparison of the chainless and ordinary wheel. "Acetylene as an Illuminant" shows some of the latest forms of apparatus for the safe and economical generation of acetylene gas. Lieut. B. W. Dunn, U. S. A., has a valuable continued paper describing "A Photographic Impact Testing Machine for Measuring the Varying Intensity of an Impulsive Force." It shows an ingenious apparatus for which the Franklin Institute recommends the award of the John Scott Legacy Medal and Premium. The second installment of Prof. Octave Chanute's "Gliding Experiments" is of rare interest to all who care for modern aviation. It is splendidly illustrated by 14 engravings made from instantaneous photographs. "The Mineral Statistics for 1897" gives important statistics of mining industry. "A Unique Case of Complete Removal of the Stomach" describes a brilliant surgical operation and is referred to elsewhere. Many of our new subscribers are possibly not familiar with the features of our SUPPLEMENT. All our readers who can afford to do so would find it to their advantage to become subscribers to both our papers.



ON THE TERRACES AT ZUNI.

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RECENTLY PATENTED INVENTIONS.

Engineering.

COMPOUND GAS ENGINE.—Edward R. Bales, Centralia, Ill. This engine is designed to reduce vibration to a minimum, to run with a comparatively small flywheel, and to utilize the motive agent to the fullest extent. It has two high pressure cylinders, their working strokes alternating, discharging into a receiver, and a low pressure cylinder having valved communication with the receiver, the low pressure cylinder being driven alternately by the exhaust gases from the high pressure cylinders. The arrangement is such that a continuous impulse is given to the main driving shaft while the engine is at work, and all parts are so completely counterbalanced that there is but little vibration.

SLOW COMBUSTION FURNACE.—August Pampus, Kiel, Germany. This furnace has a fire box with two passages in its opposite walls, one passage having a series of apertures conducting the draught upward and into the fire box and the other passage having apertures conducting the draught downward from the upper portion of the fire box into the lower part. The air is thus conducted along the whole column of fuel in such a manner that the gases are completely saturated therewith, causing an energetic production of heat and increasing the capacity of the apparatus. The invention is designed for use with stoves as well as boiler furnaces.

Railway Appliances.

CAR BRAKE.—Benjamin Jay Cobb, Shreveport, La. According to this invention the brake beams and complementary parts are raised above or level with the axles of the wheels, that persons lying on the track may not be struck by the car passing over them. A lever extends vertically adjacent to the inner side of each wheel and carries at its lower end a brake shoe, beams connecting the levers in pairs, while additional levers are connected to the beams. A link connects the additional levers with each other, and means are provided for applying power to one of the levers, the shoes swinging away from the wheels when the levers are not positively actuated.

TURNTABLE.—Gabriel Rohrbach, Del Rio, Texas. This invention relates to an improvement on a formerly patented invention of the same inventor, comprising an operating device consisting of clutch dogs adapted to engage a circular rail, a vertical shaft carrying a horizontal bar engaged at opposite ends to the clutch dogs, links connected to the clutch dogs by which their angular position may be changed, and a lever for operating the links. There are spring connections between the levers and links, and means for oscillating the vertical shaft, a long leverage being used when the turntable is started and a short leverage after it is under way.

RAILROAD RAIL.—Alexander J. Gordon, Philadelphia, Pa. For especial use for street surface cars, this rail is arranged to permit of conveniently replacing its worn-out head without disturbing the base and webbed portions and the pavement in which these parts are embedded. With this idea the base has a web formed at its upper end with a fork between the members of which is fitted a depending flange of the head, the flange having at its lower edge notches for the bolts of stay rods formed at their ends with bolts passing through the fork, thereby fastening the flange of the head in place in the fork of the base.

Electrical.

CALL BOX SYSTEM.—William T. Budds, Charleston, S. C. In wiring between a main office alarm and a series of operating call boxes, this invention provides a system whereby, should the metallic circuit be broken or grounded, the alarm may still be turned in from any one of the boxes. A break may be quickly located, without an expert lineman, by sending a messenger to ring in the several call boxes, none of which are put out of connection with the main office. A motor operates a circuit controlling wheel on one side of which is a segmental block of insulating material, a metallic plate on the block being insulated from the body of the wheel, while brushes normally resting on the plate have connection with line wires and a ground wire has connection with the body of the wheel.

Bicycles, Etc.

BICYCLE ALARM.—Fred B. Sanders, North Bend, Pa. According to this invention a spring-pressed lever clipped to the under side of the handle bar may be pressed up to force downward a rod at whose lower end is journaled a friction wheel, bringing such wheel in contact with the tire, the shaft of the friction wheel also carrying the wings of a blower inclosed in a casing provided with a whistle. Normally the spring-pressed lever holds the friction wheel out of contact with the tire, but when such lever is drawn up under or at the side of the handle bar, the friction wheel engages the tire and causes the wings of the blower to be rotated, thus sounding the whistle as long as the lever is so pressed upon.

Miscellaneous.

AMALGAMATOR.—Julius Jean, Globeville, Col. For separating the precious metals, as gold and silver, from their ores, this invention provides an apparatus designed to make such separation practically complete and which may be operated with comparatively little labor. It comprises a frame mounted to slide on rods at its corners and to be raised by a cross head and screw, an inclined trough, copper-lined, extending longitudinally through the frame, there being a comb at its discharge end, while below this trough is a second trough having a depression for mercury, there being a receiving trough below, and a funnel supported by the frame within a box.

WIRE STRETCHER.—William T. McNeill, Stoneburg, Texas. This stretcher has a body portion shaped to embrace a post, and in which is fulcrumed a lever adjustably connected with an angular pull bar, while a clasp consisting of a body bar, and having a lug and cam, is connected with the pull bar, there being a projection from the body to which is attached a second clasp, both clasps being reversible. By this device the wire may be quickly and conveniently placed under any desired tension and so held as long as desired, or the device may be utilized for drawing the ends of a broken wire together, or the ends of opposing wires, that they may be brought together and connected under tension.

HOOF SPREADER.—Philip De Loria, Lake Placid, N. Y. This device comprises a screw adapted to be mounted loosely in the toe of a horse's hoof, a block bearing against the inner side of the toe of the shoe having an eye loosely receiving the screw, there being an arm pivoted to each end of the block, the arms being extended rearward and adapted to engage the quarters of the hoof, while a crosshead threaded on the screw has sliding connection with the arms. As the screw is turned in the hoof, the crosshead is moved forward and backward, and the spreading pressure on the quarters may be regulated to cure the hoof of abnormal contraction.

MILK PAIL STRAINER.—Angus D. McLellan, Crystal, North Dakota. To prevent extraneous impurities from dropping into the milk during the milking operation, the cover of the pail, according to this invention, is made with a central opening surrounded by a metallic flange, there being over such opening a sieve, at one end of which is a plate to receive impurities. Within the flange is a casing communicating by a perpendicular tube with a funnel through which the milk is received, one end of the casing being inclined or beveled to direct the milk at an inclination against the sieve and throw the impurities upon the plate.

SAFETY ENVELOPE.—Ruth N. Smith, Patchogue, N. Y. The blank for this envelope has two foldable end flaps on which are locking tabs that may engage slots in the flaps, and two side flaps, one of which is adapted for side folding and has a keeper band produced by two spaced slots, while the opposite flap is narrowed toward the free end, on which is a lateral locking tab, the tab and the neck of the flap being adapted to pass below the keeper band when the envelope is folded, and the lateral tab to be interlocked with a single slot in the front side of the envelope. The envelope is formed of a single sheet, and is designed primarily as a closure for letters, but may be made as a safety cover of thin sheet metal, such as light tin or aluminum, for the preservation of valuable documents.

SALES SLIP ENVELOPE.—William De Witt Bates, Grafton, N. D. To render the use of sales slips more convenient and reduce their cost, this envelope is made of ordinary manila paper and entirely closed except for a narrow transverse slot across the face near one end, through which the end of the slip projects, the envelope being also provided with a carbonized or copying surface upon the inner surface, while it may likewise have a record blank upon its back. The envelopes cost so little that they may be thrown away after the original slip has been used, thus providing a fresh copying surface for each slip and insuring clearer and better copies, while preventing all handling of the carbon sheet and obviating the soiling of the fingers thereby.

RAISIN SEEDER.—Cary S. Cox, Fresno, Cal. This device has a carrying roll consisting of a shaft on which are disks having teeth inclined opposite the direction of motion, and a pressure roll having an elastic surface engaging the teeth, there being reciprocating strippers between the toothed disks, and a blade adjustable to and from the teeth of the carrying roll to receive seed from the teeth.

OINTMENT APPLICATOR.—Eugene A. Bagby, Winchester, Ky. This invention covers a pipe for conveniently applying pastes, oils, etc., internally, the pipe having external grooves and inclosing flexible sheath forming receptacles for the substance, the sheath being inflatable.

FIGURE TOY.—William F. Simon, West Hoboken, N. J. This is a toy to be made in imitation of a reptile or snake, having its body formed of a spirally coiled thin metal strip, crimped to present a contrast of light and shade. Any metal suitable for the purpose may be used, either in its natural color or with artificially produced colors or shades.

Designs.

WALL PAPER.—Arthur Martin, Paris, France. The leading feature of this design is a shield with scroll extensions and bearing a panel decorated with interlocked horns. Foliate branches extend from the border through the members of the shields, and groups of fruit apparently extend from the foliage of the stems, interlocking floral branches. Another wall paper design of the same inventor simulates a growing plant of pinks, with rich groupings of the stems and flowers, forming a chain of plants. A still further design, forming the subject of an additional patent, comprises a festooned crescent shaped garland with floral and ribbon sections, bouquets being tied at the extremities of the garland, with a centerpiece between the bouquets and over the center of the garland.

WIRE STRETCHING TOOL.—James L. Cates, Senatobia, Miss. This design is for a tool with straight handle section, having at one end a fork and at the other end a yoke body and claw.

BURNER FOR LANTERNS.—James W. Dearing, Brooklyn, N. Y. This burner has arms extending upward from a base surrounding the burner tube, the arms being of T-shape and having serrations in the upper edge of their horizontal head portions.

BOX.—Simon Weiller, New York City. This box is of cylindrical form, having disk caps and ornamental bands or panels around the body of the box adjacent thereto, while a central panel bears a decoration simulating wound braid.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Minerals sent for examination should be distinctly marked or labeled.

(7302) W. S. O. asks: 1. What office does the segmental commutator on an alternating dynamo perform? A. In a composite field alternator one winding on the field is in series with the line and armature circuit. The segmental commutator is introduced in this field circuit, and it rectifies the current only in the field circuit. Sometimes the field circuit is shunted so that only part of the current is rectified. This causes the machine to act like a compound wound direct current machine, in which the strength of field, and therefore the voltage, depends upon the current in the outside circuit. 2. Does it change a portion of the current into a pulsating current when it is shunted off through the field to assist in exciting the field? A. It changes a part of the current, which helps to magnetize the field and thus increase the voltage to account for loss in armature and line. 3. If the entire current from an alternator were commutated into a pulsating current, would the current not be as efficient to transform, and also have the advantage of being adaptable for direct current motors? A. It would not be as efficient to transform, as you would have to use rotary transformers to vary the voltage. In all direct current machines the currents generated are alternating and rectified by the commutator. 4. Has there yet been built a practical machine to generate direct current that can be taken from the machine through ordinary collector rings? Thus dispensing with the commutator. A. No.

(7303) W. H. S. asks: 1. Can a telescope be used with a kodak for taking the picture of an object some distance away? If so, how distant an object (as a person) could be taken in this way? A. Yes; the size of the picture depends on the size of the telescope. With a small telescope it would be minute. The difficulties would be great, due to vibration of telescope and long exposure required. 2. How should they be arranged together, the kodak and telescope? A. Take out the eyepiece of telescope and lens of camera, and fit the opening into camera where the lens was upon end of telescope, where eyepiece was. Then focus object upon ground glass of camera as in the ordinary way. You have, you see, a long camera. The object lens of telescope is now the camera lens. 3. How can lantern slides be made from negatives, provided one has camera? A. Lantern slides are very often made without a camera by contact method. A good book on slide making is by D. L. Elmendorf, price $1 by mail. 4. Can a reducing or enlarging camera be made from a kodak? A. No; the bellows of a kodak is too short for the purpose, and in all good enlarging cameras the lens is in the middle, with a bellows on each side of it. The negative is at one end, the plate holder is at the other. With some ingenuity and mechanical skill, a copying camera can be made from an ordinary camera. Set the lens out on an extension tube, and put a light-tight wooden box on the end of the lens to hold the negative.

(7304) J. B. asks: 1. Is the action in ordinary gravity batteries identical with that in the electroplating bath? A. So far as coating the copper plate with copper goes, the action is the same. The action in the upper part of the battery jar upon the zinc is not like that in a plating bath. 2. What becomes of the zinc? A. The zinc combines with sulphuric acid to form zinc sulphate. This appears as a white crystal on the sides of the jar above the liquid. 3. What is that accumulation on the copper? That brown sediment in bottom of jar? A. Copper is deposited on the copper and copper oxide is the brown sediment. 4. Why is blue vitriol necessary? A. It prevents the polarization of the copper plate. 5. When the sounder lever is held stationary, the signals can still be heard in a very subdued click. Explain this. A. That is because you do not really hold the lever still. If it did not move at all, there would be no sound. Permit us to advise you to read carefully some elementary text book of electricity and to perform all the experiments you can manage to do with the tools and materials at your command. If there is a high school in your place, the teacher will doubtless be glad to advise you. Any very elementary book will explain the batteries and their action. Avery's "School Physics" is a very good one.

(7305) A. C. M. asks: 1. Can the fields of the small alternating current dynamo described in SCIENTIFIC AMERICAN, September 11, be wound with No. 20 wire to be used as a shunt? If so, please explain how to wind. A. The field of the alternator cannot be connected in shunt with the armature, but constitutes a separate circuit which must be excited by a battery or a direct current from lighting circuit. No. 20 copper wire should be used on the fields, wound as directed in the paper. 2. I have the No. 20 wire for field, and if I cannot use it as a shunt, how should it be wound to use primary battery, and what amount of battery will it require? A. Use 5 to 8 cells of battery to excite the field, Edison-Lalande or bichromate.

(7306) G. B. writes: I am building an alternating dynamo as described in the SCIENTIFIC AMERICAN of September 11, 1897. Would like to know whether the size of wire given in the paper would do to use in case I would want to excite the machine by batteries. If not, would like to know the size of wire necessary, also the number of turns of same and the most suitable battery to excite same with. A. Wind the armature just as directed in the original instructions. For the field wind 300 turns No. 20 double cotton covered wire on each spool. Excite the field with some form of bichromate battery or with the Edison-Lalande battery, type R of which will be found serviceable. Use about 5 cells.

(7307) J F. writes: 1. In vol. 72, No. 7, of the SCIENTIFIC AMERICAN, the size of the wire of the induction coil for the solid back transmitter is given as No. 16 A. W. G. for the primary and No. 23 for the secondary coil. Does the A. W. G. mean American wire gage (B. & S.)? If so, is No. 23 wire fine enough for the secondary coil? A. We have not made the coil in question, but have no reason to doubt the correctness of the wire numbers there given. A variation of a few numbers cannot be important. If you wish to use the same number of turns of finer wire in the secondary, you can do so. A. W. G. is for American wire gage. The sizes are the same as in the Brown & Sharpe gage; but, when the gage is made by other reputable makers, they would hardly mark their work B. & S. A. W. G. is the better designation. 2. Is a permanent magnet weakened by magnetizing another piece of steel with it? A. No.

(7308) J. S. H. writes: I have a ¼ horse power No. 2 dynamo. In the directions for winding, it says to use 8 pounds of No. 14 wire (B. & S.) for the fields and 1½ pounds of No. 18 for armature. This makes a series wound for 25 volts and 8 amperes. I want to know the size of wire and the number of pounds it will take for a shunt wound for 50 volts and 4 amperes. It is a direct current dynamo, with a 12 slot illuminated drum armature, 2 inches in diameter and 4 inches long? A. Use No. 21 wire for armature, putting on twice the number of turns as before. For the field, use 10,000 feet of No. 20 wire.

(7309) H. W. asks: 1. Please give size of wire for field and armature to wind Parkhurst motor for dynamo for nickel plating, if it is possible, in SUPPLEMENT, No. 759. A. The machine is properly wound as described for nickel plating. Use large wire for conductors, and place a variable resistance in series with the bath. 2. Can 8 light dynamo be wound for lighting and use the same with lower speed for nickel plating; if so, will you please give size of wire? A. It would not be advisable to wind the machine for both lighting and plating, as the voltage would be too low to transmit the current any great distance through a reasonable size wire. 3. Possibly I could wind field for both outputs and have two armatures, one for lighting and one for plating. A. You can, by using No. 12 wire and winding 4 turns to a coil instead of 16 turns of No. 20 on armature. For the fields use present winding, connecting two coils of the fields in series with each other and in parallel with the other two coils similarly connected together (series). Also place in series with the fields 2½ ohms resistance and connect the fields in shunt. Use a variable resistance between the bath and the machine. You can obtain about 30 amperes thus wound. Your commutator and brushes should be made larger to carry the heavier current.

(7310) R. W. M. asks: 1. As to the Fuller cell? A. The 3 cells you name are for very different purposes. The Fuller cell is for telegraphic and similar work. 2. As to the Latimer Clark? A. The Latimer Clark is a cell for measuring E. M. F., a standard cell, and gives no current. It has no commercial use. 3. As to the Schanschieff? I wish to know about their comparative first cost, cost of running, and lengths of time they run at one charging. I would also like to know about the difficulty of making each. A. You will be able to get prices from firms named in our advertising columns. Many forms of cells are described in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 157, 158 and 159. Price 10 cents each, by mail. The best book on batteries is "Primary Batteries," by H. S. Carhart. Price $1.50, by mail.

(7311) J. G. L. writes: 1. I have a C. & C. battery motor, made by the C. & C. Electric Motor Company, of New York. Motor was made about ten years ago. Is stamped, "Speed 2,200; Type 1 A.; Amperes (blank); Volts, 6." Can this motor, by rewinding or otherwise, be converted into a dynamo? If so, how? And what capacity would it possibly have? A. Your motor is already wound as it would be for a dynamo giving about the volts and amperes it consumes as a motor, at the same speed. To determine its amperes measure the current in the line when it is running. All that is necessary to use it for a dynamo is to connect it to a source of power and drive its armature 2,200 turns per minute. 2. Where can I procure castings, parts, specifi-

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cations, etc., of a dynamo that will require one-half to two-thirds horse power to drive it? A. Our advertising columns carry the names of firms dealing in these articles.

(7312) W. J. K. asks: 1. How many ounces of tungstate of calcium would it take to cover a screen 6 by 8 inches square? A. Two ounces, if laid on with great uniformity. 2. I am wishing to make a "Tesla" transformer (similar to the one described in Dr. Morton's X ray) to transform a 2-inch spark of a small static machine to a 6-inch spark to excite an X ray tube. Could you give me any advice as to the way to make it? A. The Tesla coil is fully described in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1087 and 1124, price ten cents each by mail. We do not think the spark of a small static machine can be transformed as you suggest. The original discharge is not powerful enough to be transformed to so high a voltage. 3. I have started to make a transformer similar to the above one. I took a pasteboard tube ⅝ inch outside diameter, ⅛ inch inside diameter and 7 inches long, and wound one layer (about 13 feet) rubber insulated wire around it, No. 18, and now I have started to wind on the secondary, No. 30, single cotton covered. How much wire will I need to produce the 6-inch spark? 4. Have I enough primary on? A. Follow the directions of the SUPPLEMENTS referred to above. 5. If I use oil insulation, what kind ought I to use, and where can I get it? A. Paraffine oil.

(7313) J. F. A. R. writes: I have built the eight light dynamo as described in SUPPLEMENT, No. 600. 1. I would like to wind a new armature so that I can use it as a motor on a 550 volt current. Now, what size wire shall I wind on armature, and what size on field, so that by changing armatures I can use it as a motor and a dynamo. 2. Can I make and wind an armature so as to get a 110 volt current with the field winding for the other two armatures; if so, what size and how much? Could I increase the number of commutator bars and coils, say, to 30? Cannot the field winding be arranged so as to increase or diminish the amperage at will? Have had the dynamo with its present winding connected with the 550 volt current, but had to disconnect all but one coil or layer on each leg, so as to prevent blowing out the 15 ampere fuses; with the one coil the ammeter still read 10 amperes. I would like to make the armature and field winding so that as a motor it will not read over 7 or 8 amperes, even less if possible. A. On account of the very high voltage it would not be advisable to use the machine for 550 volts as well as 60. To wind it for 550 volts as a motor, make the commutator with 48 sections instead of 24, slot the end of the bar and solder the wires in the slot, instead of using screws. Make the bore of the fields 3¾ inches. Wind the armature with No. 26 wire, putting on 63 convolutions in each of the 48 sections, winding 3 layers deep, 21 turns per layer. For the fields use No. 28 wire, winding 50 layers on each leg. Connect the two sides in series and use as a shunt circuit. As a starting box connect a bank of ten 50 volt lamps in series with the machine, cutting the lamps out one at a time as the machine comes up to speed. In winding insulate thoroughly, using best insulated wire. Do not allow more than one ampere to pass through machine. In a motor the current which it takes depends upon the amount of work which it is doing and not upon the field winding.

(7314) H. H. asks for instructions for making and setting up a sun dial for (approximately) 43° 40′ N. latitude, 75° 20′ E. longitude. As I am only an amateur, the easier the modus operandi and the simpler the mathematical formulas, the better. A. The construction of a sun dial is described with illustrations in SCIENTIFIC AMERICAN SUPPLEMENT, No. 873. Much information regarding them, with illustrations, may be found in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 631, 796, 810, 866, 932, price 10 cents each by mail. The edge of the vertical plate which casts the shadow must make an angle with the horizontal plate equal to the latitude of the place where the dial is to be used. In your case, this angle is 43° 40′. The longitude is not concerned.

(7315) J. O. K. asks: 1. When smoke ascends from chimneys in a straight line, is it a proof of rarity or density of the air? A. Smoke rises when it is lighter than the air. Of course, then the air is denser when the smoke rises than when it does not rise. 2. Should not the field magnets of motor, Edison style, be wound in different directions? A. These magnets are wound so that the pole piece on one side of the armature is +, and that on the other side —. 3. Is there any transformer made for street car currents? A. Yes. A. rotary transformer. The current from the line runs the machine as a motor, and a winding in the armatnre gives a current of the voltage and character required, direct or alternating. 4. What is the meaning of two or three phase systems, etc.? A. A 3-phase system employs an alternating current which flows in three impulses, each ⅓ of an alternation behind the next. Similarly define a 2-phase system.

(7316) D. B. asks: Of what size, proportion, and what size of wire should an electro-magnet be made to produce the greatest amount (approximately) of magnetism from a Leclanche or a good dry cell contact to last 1½ seconds every minute? Should one or two spools be used? A. Use a ⅜ inch soft iron rod, about 2 inches long, for the core of the magnet, and wind on No. 20 or 24 silk covered copper wire to a depth of ⅜ to ½ inch. Two spools will attract an armature much more strongly than one.

(7317) E. R. B. writes: Have a Baush & Lomb student's microscope, ¾ inch eye piece and objectives 1 inch and ¼ inch. Is there a possibility of rigging the instrument up so that I could project the subject on a screen of ground glass? Intend to use 50 candle power acetylene flame at close range. The mechanical part I can handle, but it is in optics that I am a little "shy." A. Take the eye piece out of the microscope and set the tube horizontal. Inclose the light in a box so that the room may be dark, and have an opening into the box against which the stage of the microscope should be placed. Adjust focus till image is distinct on screen. The size of image depends upon the distance of screen from microscope. Good books for you are "The Art of Projecting," A. E. Dolbear, price $2 by mail; and much that is in Hopkins' "Experimental Science," price $4 by mail.

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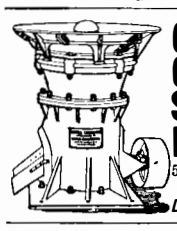

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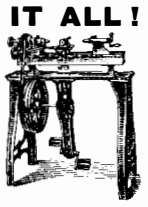

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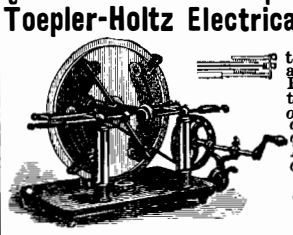

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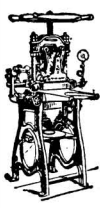

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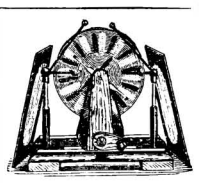

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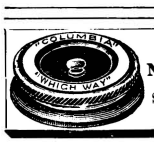

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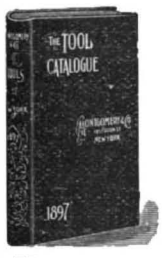

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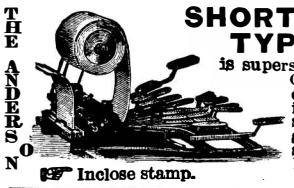

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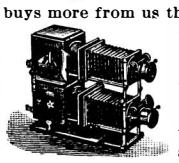

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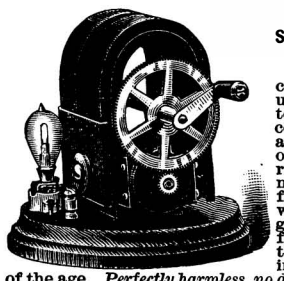

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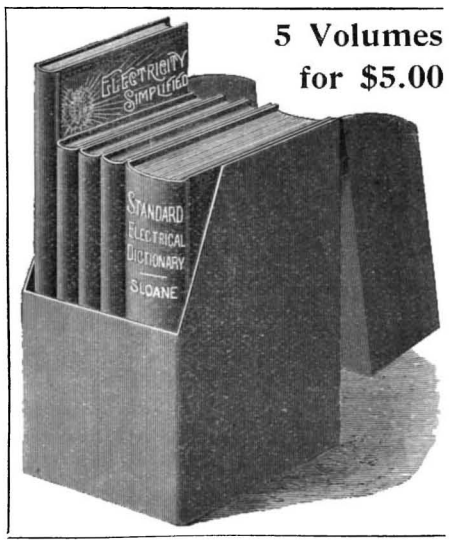

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